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JANUARY, 1945

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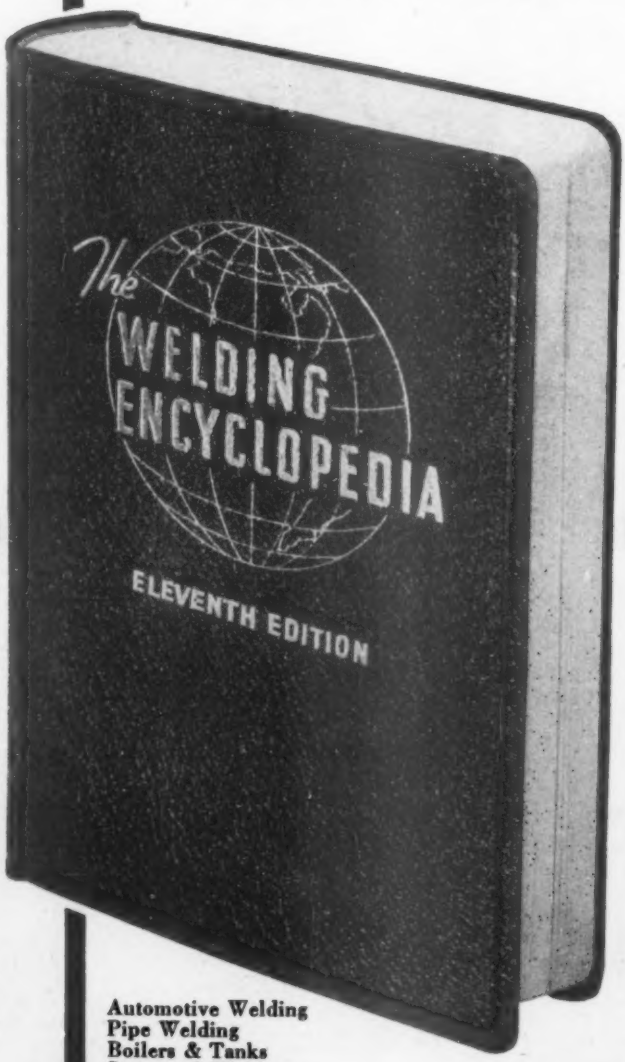

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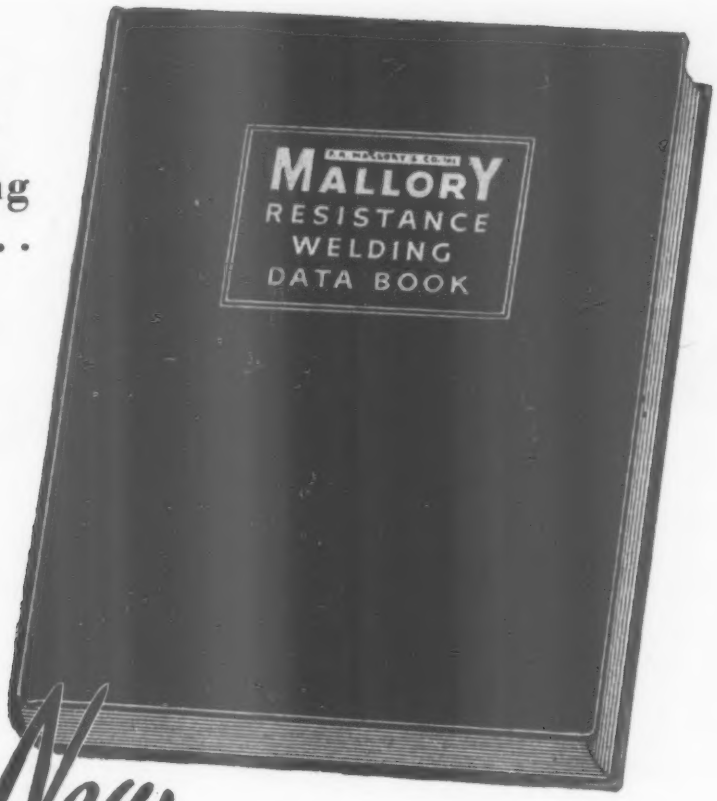

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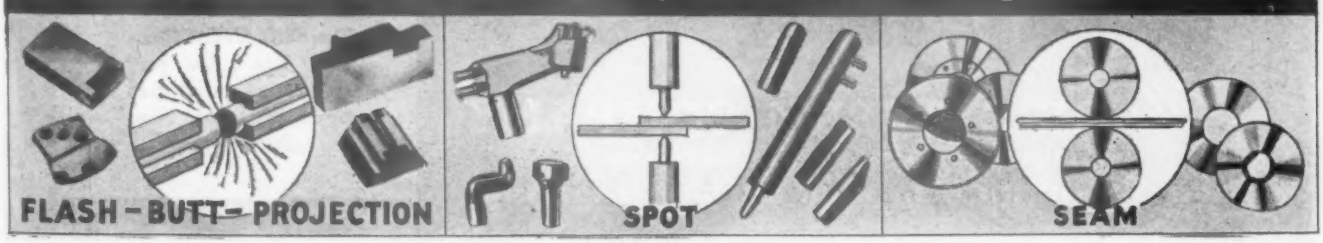

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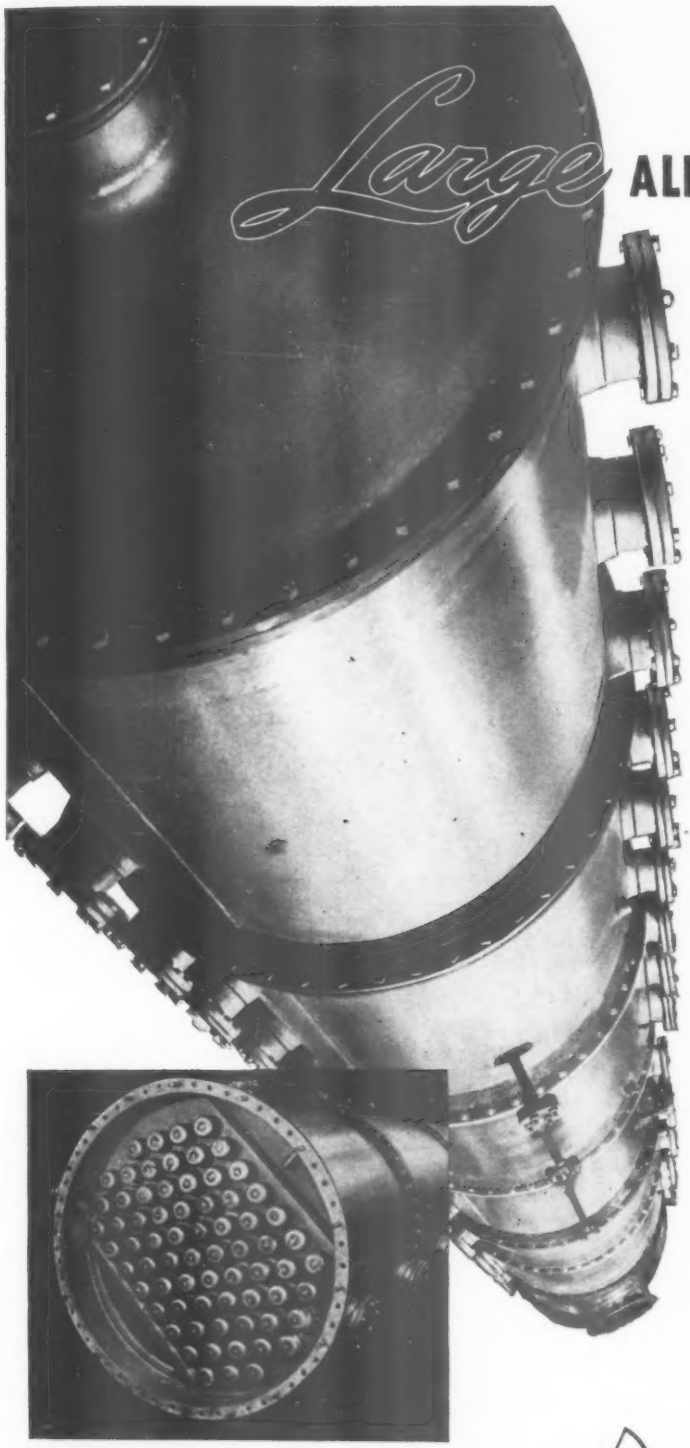

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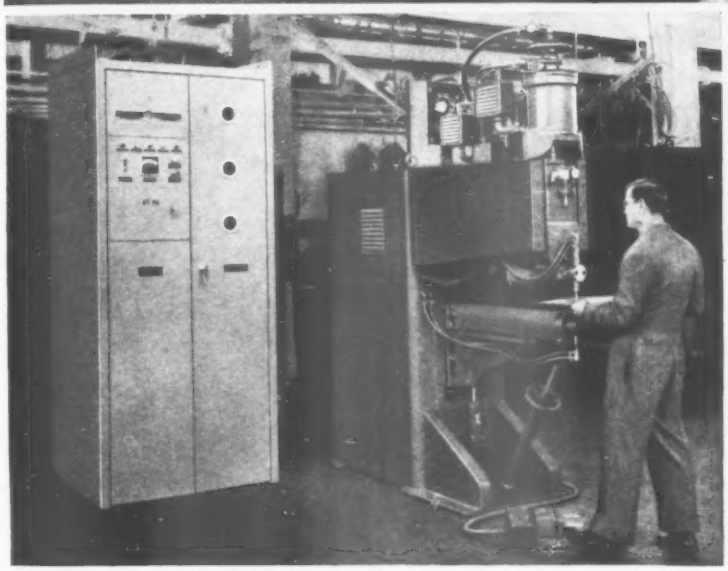

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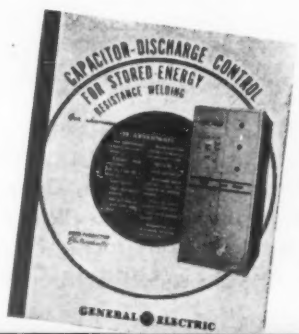

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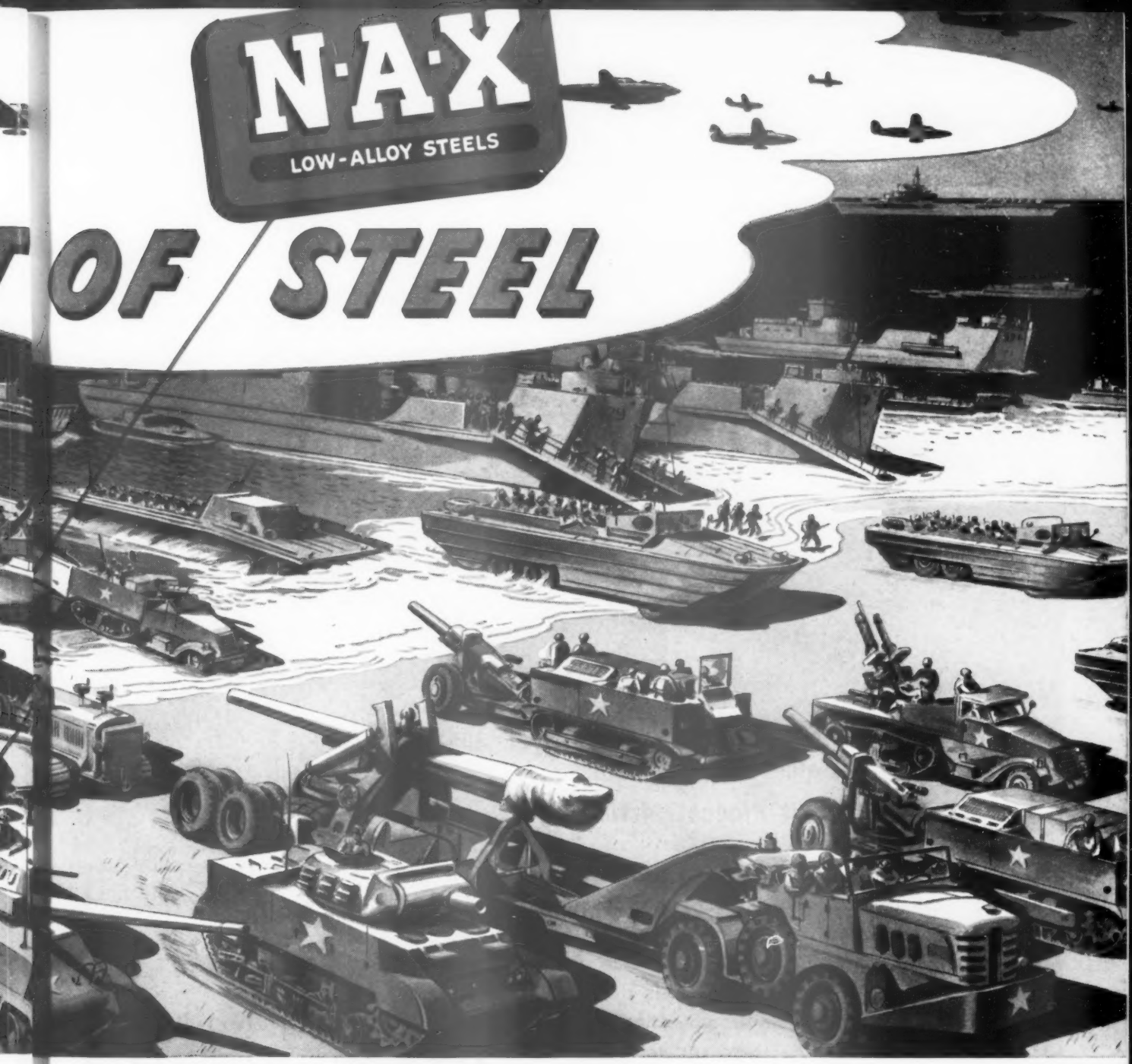

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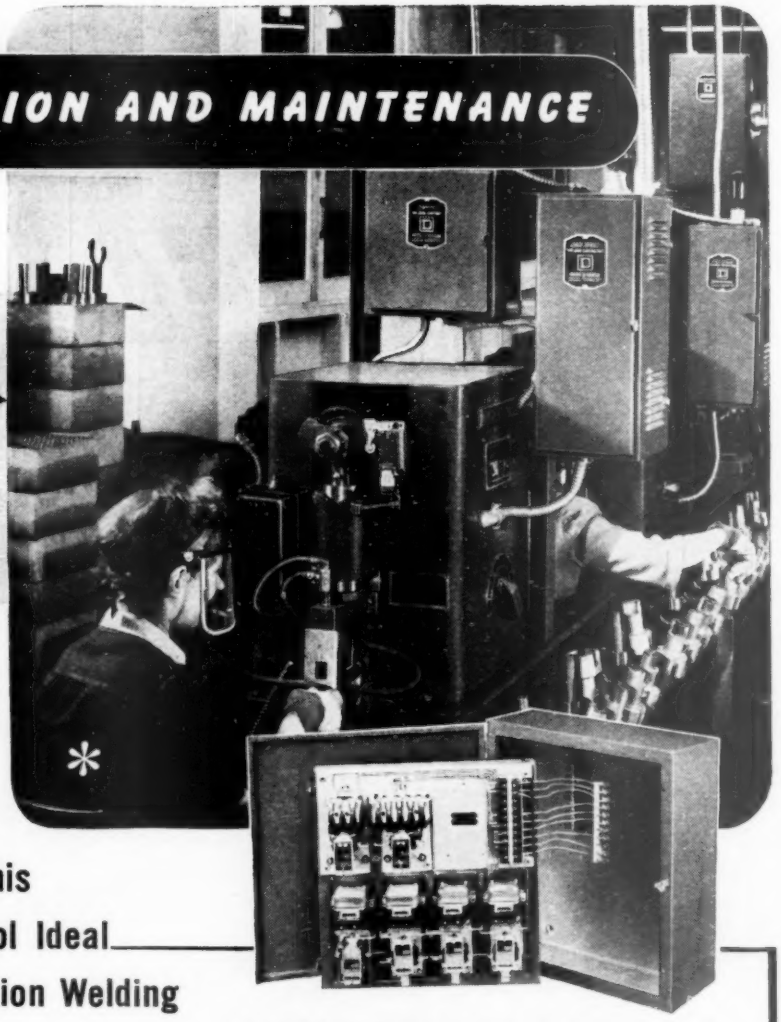

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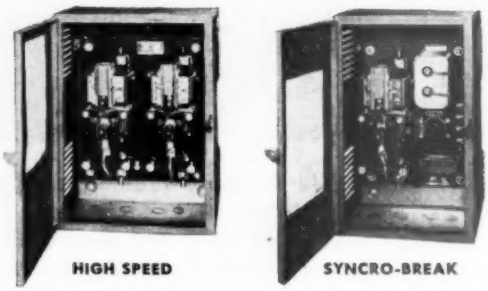

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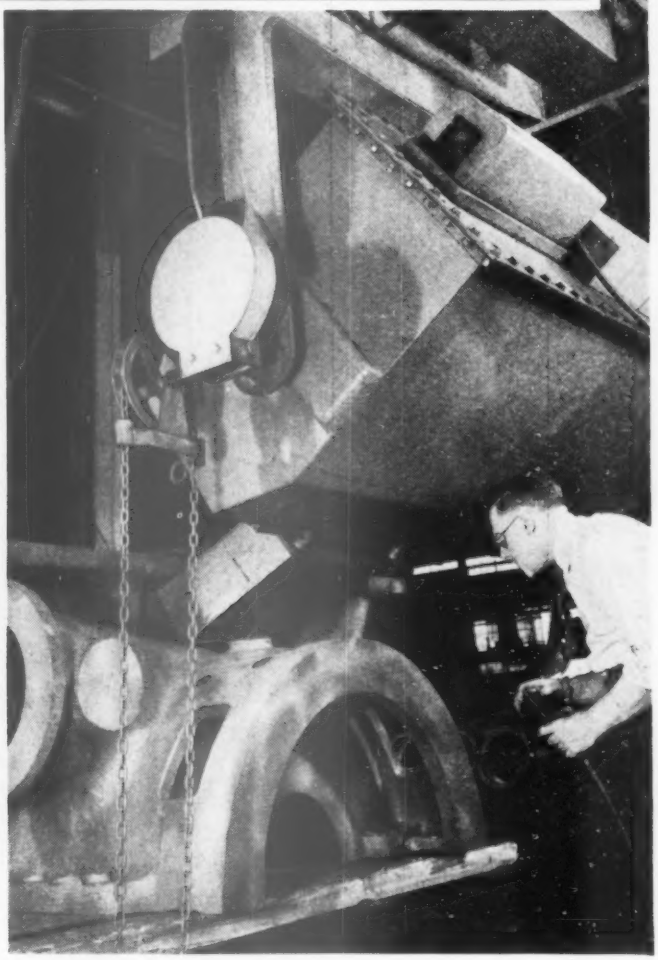

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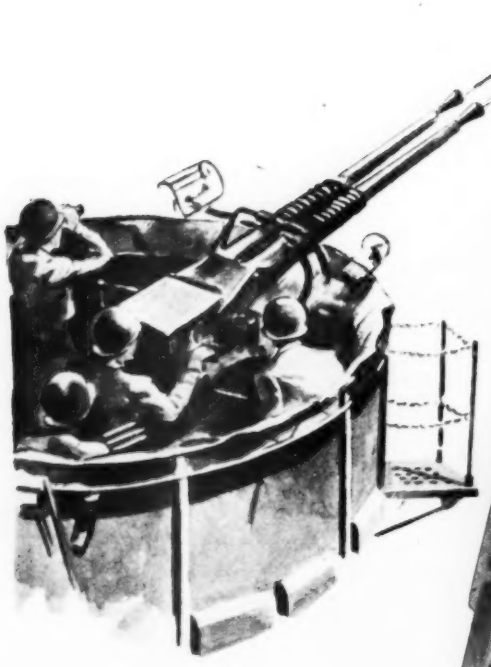

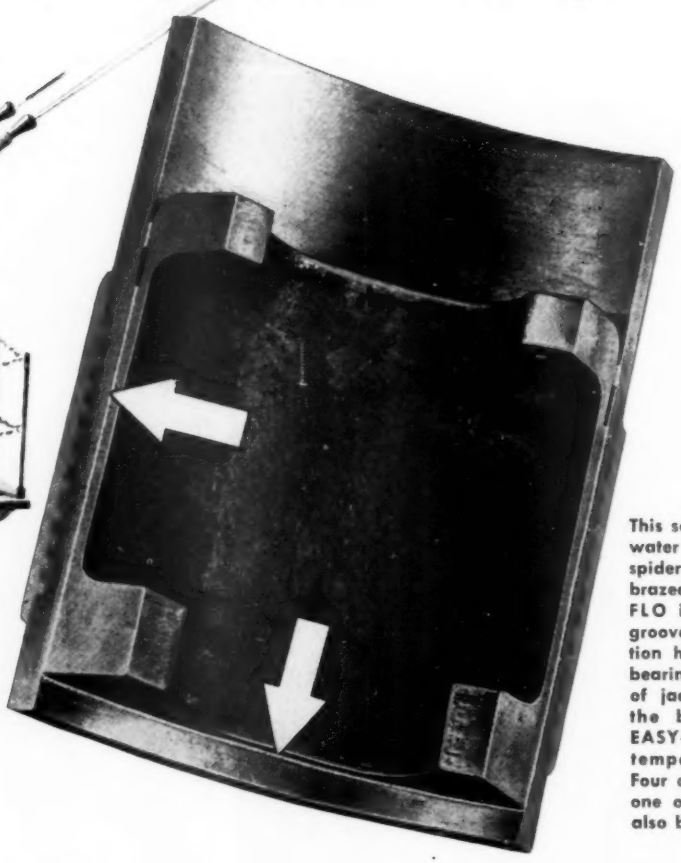

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☆ On the Production Front . . . on the Battle Front—Meco oxy-acetylene welding and cutting equipment is speeding the day of Victory. ☆ The reliable operation of Meco Safe-T-Chek Regulators reduce production hazards—saves manhours . . . saves time . . . reduces costs. ☆ If you have been disappointed on deliveries of Meco Equipment, bear in mind that every shipment we make is based on the Victory Cause. Meco Equipment is vital to war production. Oxy-Acetylene Cutting and Welding outfits are standard equipment of all of our armed forces, including the ships at sea.

Meco

Oxy-Acetylene Cutting and Welding Equipment

MODERN ENGINEERING CO.

3413 PINE BOULEVARD ST. LOUIS, MISSOURI

FOR HIGHEST QUALITY WELDING VERTICAL AND OVERHEAD YOU CAN'T BEAT THESE G-E ELECTRODES

YOU can't afford to compromise when choosing electrodes for first-class welding in the vertical or overhead position, because that kind of welding calls for the *best* in both technique and electrodes. That's why operators prefer these two G-E electrodes--they find them mighty helpful in meeting specifications.

W-26 electrode is recommended for use with *a-c;* easily meets *all* the requirements of A.W.S. Class E6011. It is approved by regulating bodies for both E6011 and E6010. (Therefore it can also be used for d-c.)

W-22 electrode is recommended exclusively for use with *d-c.* It meets *all* the requirements of A.W.S. Class E6010, and is approved accordingly.

Both electrodes produce weld metal which has the *highest* mechanical properties. And both are *easy* to use. They provide a forceful, digging type of arc which gives deep penetration, excellent fusion, and a strong, ductile deposit in all positions. Slag is light and easy to remove. Fillet welds have good appearance and a relatively flat profile.

If you are not one of the thousands already using these production proved electrodes, it will pay you to ask your G-E arc-welding distributor for samples to test in your own shop. He will also be glad to furnish samples and information about other G-E electrodes. Or, write to General Electric, Schenectady 5, N. Y.

GENERAL ELECTRIC

673-58-8750

● **Surface appearance** of welds made in the vertical position with both the W-26 and the W-22 electrode is unusually good. Both these electrodes can also be used in the overhead, horizontal, and flat positions with equally good results.

● **Excellent penetration, good** fusion, and flat contour are easily obtained with both W-26 and W-22 electrodes. These etched cross sections of welds made in the vertical position are typical of results obtained with these electrodes.

Hundreds of Landing Barges have been fabricated with General Electric a-c welders and W-26 electrodes at the Trageser Copper Works, Maspeth, L. I., N. Y.

ANOTHER User Tells Why He Prefers A-C Welding

"Our operators prefer a-c welders because, with a-c, they don't have to worry about arc blow — they can weld in every position and in every location and get a good strong joint every time. What's more, our General Electric a-c welders have been operating 20 hours a day, six days a week, for more than two years, and not one has ever required maintenance."

TRAGESER COPPER WORKS

That statement is typical of comments made by virtually every manufacturer who has changed from d-c to General Electric a-c welders. For full details on how a-c welding can help you improve weld quality, increase production, and reduce costs, ask for Bulletin GEA-4081. Simply contact your G-E arc-welding distributor or write to General Electric Company, Schenectady 5, N. Y.

ARC WELDING ELECTRODES and EQUIPMENT

Buy all the BONDS you can
— and keep all you buy

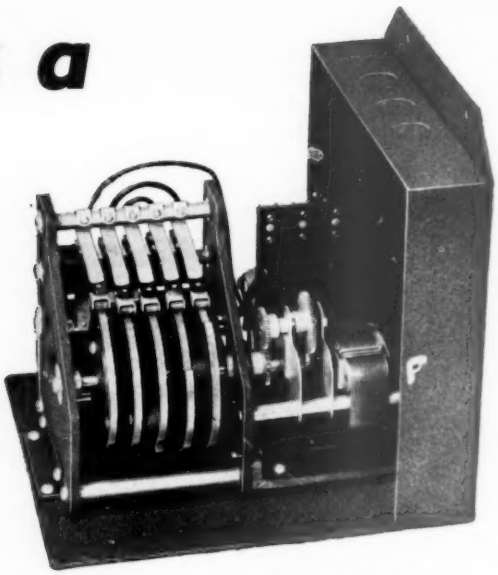
It's New!...It's a

NATIONAL

Precision

WELD-TIMER

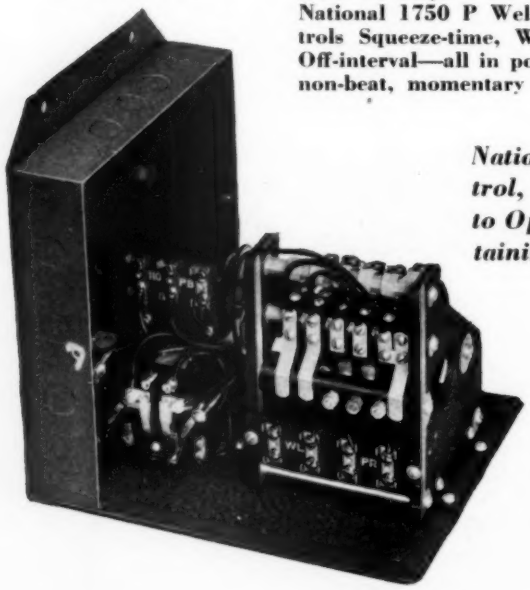
- ***Improved Design — More Accessible — Easy to Service***
- ***A Complete Weld–Control Sequence Panel***



1750 P Weld-Timer
Right Hand View

Presenting National's new improved 1945 model 1750 P Timer. Here is a weld-control that your maintenance man needs—and wants! It is simple. It is easy to regulate. It keeps every operating function in full view. With it, you can chart a safe course for metal through the fusing operations—you can speed up production, eliminate human irregularities, and make every weld UNIFORM! . . . In pre-war days more than 10,000 automobiles were sold DAILY welded by National precision timers . . . Our old model was excellent—reputed to be the most efficient on the market—this new 1945 model is even better!

1750 P Weld-Timer
Left Hand View



America's amazing war production has emphasized the value of welding controls—they are Here to Stay! . . . For example, note what National 1750 P Weld-Timer will do—it controls Squeeze-time, Weld-time, Hold-time and Off-interval—all in positive sequence. It has a non-beat, momentary push control circuit; if push button is held, timer will repeat at a preset, timed rate, with ample time between welds, to move metal. It is ideal for welding-guns at high speed, or on stationary fixtures where welding is slow . . . Weld-intervals as short as one-half cycle, or as long as 20 cycles, can be consistently maintained.

National's patented double-cam per circuit time control, of 'Drop to Make Contact' followed by 'Drop to Open Circuit,' is the only known method of maintaining this precision accuracy in a mechanical timer!

The acceptance of National as the preferred weld-timer is proven by re-orders we receive. One manufacturer has MORE than 400 Type 1750 P units alone! Numerous manufacturers of automobiles, refrigerators, and electrical equipment, each have more than 100 National timers in operation. . . . The "story" is always the same—once a National is used, more Nationals follow.

Get the facts—write us today—let us show you How and Why the National is the Ideal Weld-Timer for YOUR production.

NATIONAL TIME & SIGNAL CORPORATION

600 E. MILWAUKEE AVENUE DETROIT 2, MICHIGAN

Official U. S. Air Forces Photo

THUNDERING through the sub-stratosphere with trails of vapor marking their course, American bombers and swift fighters deliver smashing blows at the enemy. These high-altitude sweeps could not be made without oxygen, which means life itself for the flyers at more than 10,000 feet. *Air Products* mobile and stationary generators supply this necessary oxygen on many battlefronts scattered all over the world.

Air Products is concentrating today on oxygen generators for military use, and will continue to do so until every victory is won. After the war the company will resume construction for industry of modern, efficient mobile and stationary generators using the air liquefaction process for the production of oxygen, nitrogen and other gases contained in the air.

Air Products
INCORPORATED

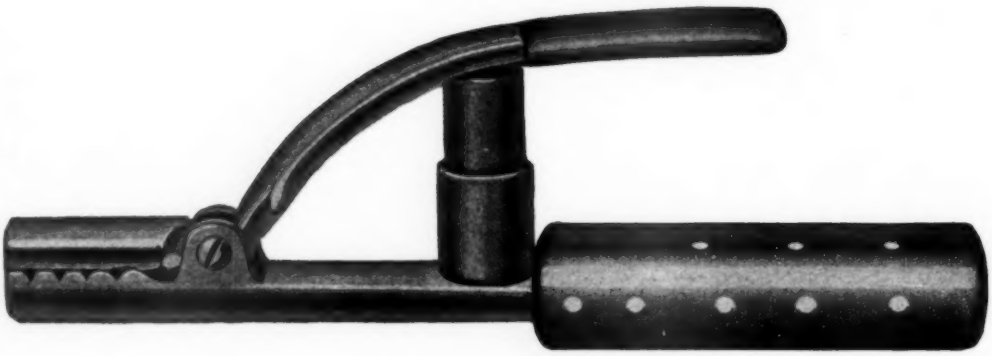
Manufacturers Road, Chattanooga 5, Tenn.

Stationary Oxygen Generator

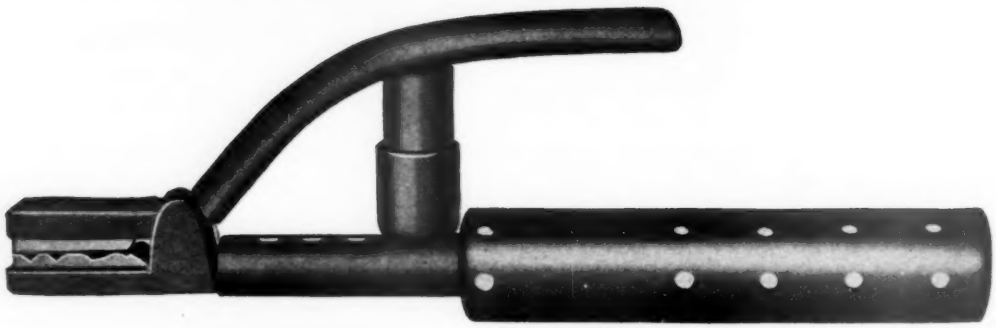
Trailer Model of Mobile Oxygen Generator

THERM-ARC ELECTRODE HOLDERS

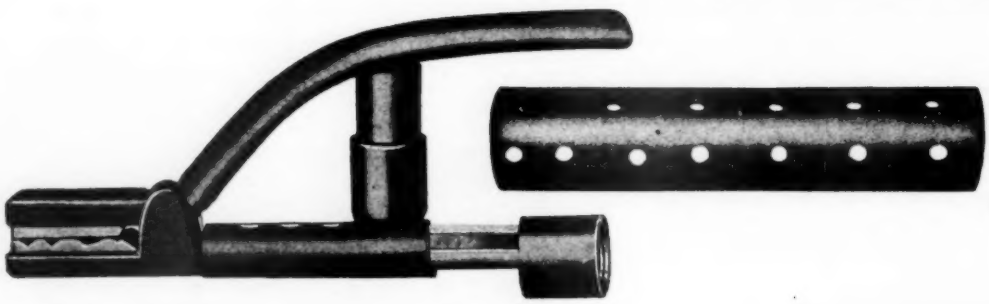
A Type of Holder that has Proven Itself
The only fully-insulated coil spring holder



TYPE N
Partially Insulated



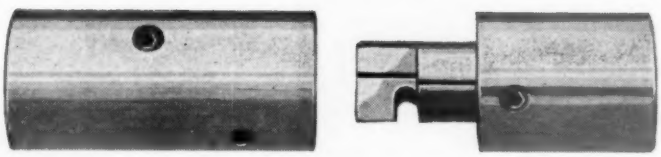
TYPE K
Completely Insulated



TYPE M
Detachable Completely Insulated With Removable Front

THERM-ARC CABLE CONNECTOR

This unit can be connected or disconnected quickly by a very short turn. The action is instantaneous and a tight, contacting connection is assured throughout entire circumference of male plug; no possibility of loosening while in use.



Write for our attractive, illustrated, descriptive booklet of THERMEX Holders and Cable Connectors.

THERMEX EQUIPMENT COMPANY

2045 Celia St. **Tel. TYler 7-1337**

DETROIT 8, MICH.

THE Hard-Facing ANALYZER

THIS MONTH'S WEAR PROBLEM: MILL HAMMERS

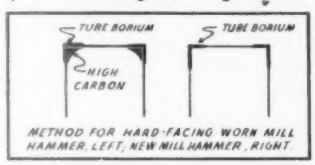
Selecting the proper hard-facing alloy for any job must always be based upon operating conditions which vary infinitely between applications. The proper hard metal for hard-facing MILL HAMMERS must:

- WITHSTAND ABRASION OF HAY AGAINST METAL.
- KEEP POINTS OF HAMMERS OUT TO SIZE.
- RETAIN SHARP CUTTING EDGES FOR FULL CUTTING EFFICIENCY.

CUTTING hay sounds like a soft job, yet abrasion is severe, quickly rounding away hammer corners during the high-speed rotation so necessary for efficient chopping. Because of this concentrated abrasion hammers lose size, with consequent loss of cut-hay tonnage and unnecessary down-time for hammer changes.

Stoody Tube Borium proves the ideal hard-facing alloy for mill hammers when used for chopping hay. *Tube Borium not only produces a 50% increase in tonnage per day, but hammers hard-faced with Tube Borium stay sharp 10 times longer than unprotected hammers and greatly outwear those hard-faced with inferior alloys!*

TWO PROCEDURES cover the hard-facing of mill hammers. New hammers need only to be surfaced on the top and outside edges as shown. Worn hammers require rebuilding with high carbon then surfacing on top and side edges with Tube Borium. When rebuilding worn hammers, corners should be flared out slightly beyond the dimensions of the old hammer.



METHOD FOR HARD-FACING WORN MILL HAMMER, LEFT; NEW MILL HAMMER, RIGHT.

HIGH ECONOMY—Considering cost of new hammers to vary from 60 to 90c, Tube Borium applications show high economy. 30-40 mesh Tube Borium costs $3.20 per lb., f.o.b. Whittier or distributors' warehouses. One-half ounce of Tube Borium (cost—10c) adequately hard-faces both corners of a new hammer with gas consumption generously estimated at an additional dime. Therefore, 20c worth of materials *increases hay output 150% and keeps the hammer in top cutting efficiency 10 times longer . . . a profit paying investment hard to duplicate!*

STOODY COMPANY
1141 WEST SLAUSON AVENUE, WHITTIER, CALIFORNIA

STOODY HARD-FACING ALLOYS
Retard wear . . . Save Repair

"A-C transformer-type welders? I'd buy 'em from TRANSFORMER HEADQUARTERS!"

"Who do you mean, Steve?"

"Why, Westinghouse, of course. Any a-c welder is built around a transformer, and Westinghouse has been building all types of transformers longer than anybody else—so I'd suggest we get 'em from the outfit that's recognized as transformer headquarters."

A-c welders *are* essentially transformers. That's why Westinghouse A-C Welders offer the benefit of more years of experience in the designing and building of this type of equipment than any other welder . . . because Westinghouse built the first successful commercial transformers.

A-c electrodes, too, have been developed, tested and proved by Westinghouse to meet welding requirements that range from the lightest welding to the heaviest. In fact, Westinghouse A-C Welders and Electrodes provide the right combination for faster, more economical industrial welding—maintenance, fabrication or construction.

Westinghouse A-C Welders are available in a complete range of ratings from 100 to 2000 amperes. Ask for catalog B-3136 giving full details. Westinghouse Electric & Manufacturing Co., Box 868, Pittsburgh 30, Pa.

J-21315

Westinghouse

A-C WELDERS and ELECTRODES

SMITHway CERTIFIED ELECTRODES... made by welders... for welders

SIGNAL CORPS PHOTO

NINE LST CONTRACTORS • ALL USED SMITHway ELECTRODES

WHEN nine big Midwest contractors tackled the gigantic landing-ships production program, there was no guesswork. All nine, of their own accord, chose SMITHway Certified Electrodes... developed and proved in the huge A. O. Smith plants, where millions of SMITHway Electrodes are used in welding more than 50,000 tons of steel products a month. No other electrodes offer such outstanding performance proof, over a period of many years of mass production.

WRITE FOR CATALOG!

New steels, involving new welding problems, are finding broader fields of application where strength with light weight is required. Be prepared to make the most of welding as a production tool on a thoroughly scientific basis. SMITHway Certified Electrodes provide a variety of accurately controlled analyses for dependable results — proved so, in our own welding shops where many complex alloys are daily being welded in production.

Have You Bought That Extra War Bond This Month?

Mild Steel... High Tensile... and Stainless Steel WELDING ELECTRODES

SMITHway A. C. Welding Machine saves power; eliminates arc blow.

SMITHway Welding Monitor trains welders faster.

A. O. SMITH Corporation

MILWAUKEE • WISCONSIN • HOUSTON • TEXAS

In Canada — JOHN INGLIS CO., LIMITED

"Here's the kind of hand protection every welder wants"

Ask a welder what he wants in a glove . . . and he'll tell you he wants protection with plenty of working comfort.

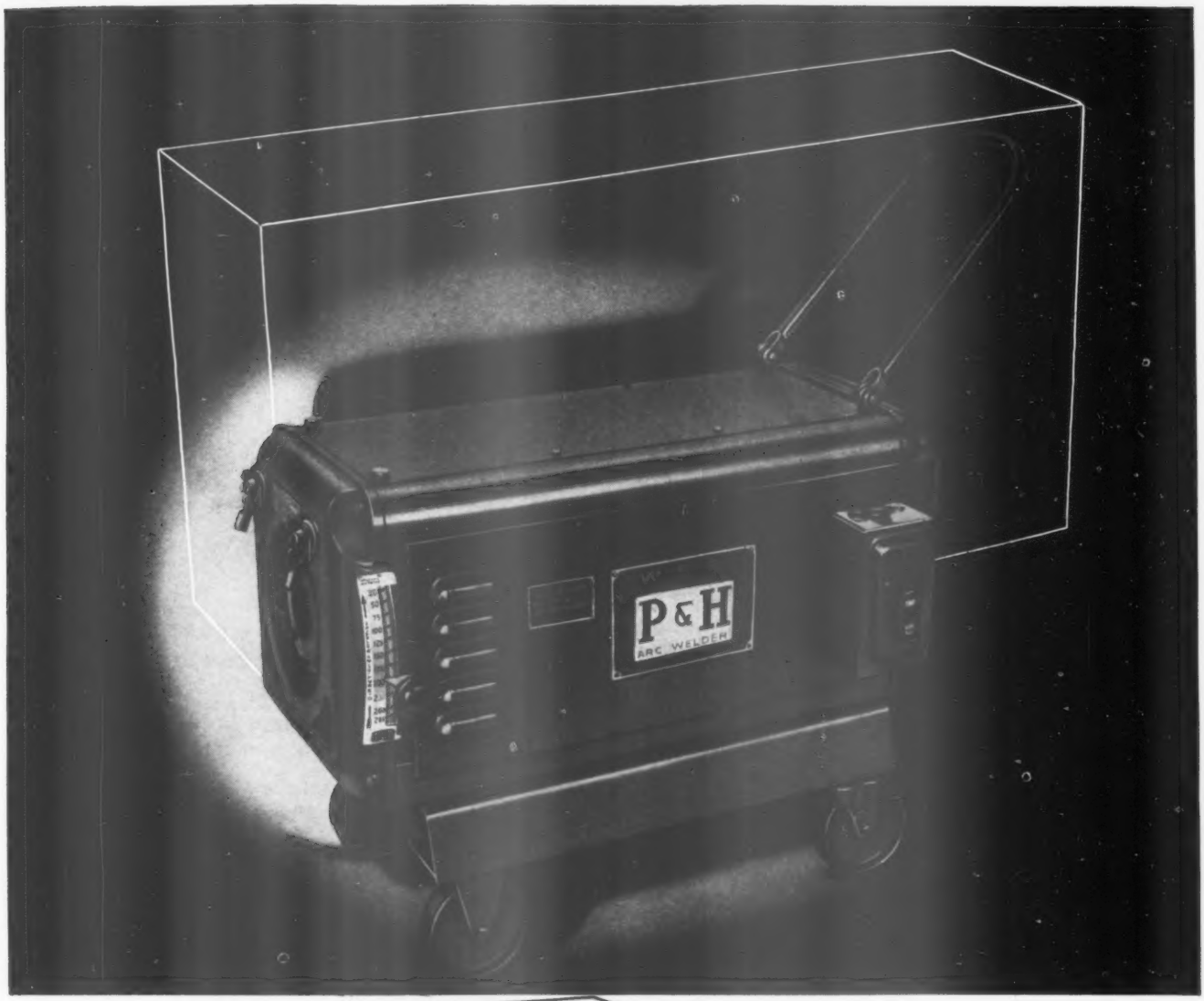
Take this pair of American Optical gloves. They're gun-cut—which means they have seamless palms—and the finger seams are flat to guard against chafing and blistering. And they're made of top quality chrome tanned cowhide that *stays* pliable. This can make the difference between an ordinary welding job and a good job. For *pliable* gloves give better control of both rod and torch. They help welders do faster, more uniform work.

The seams on AO gloves are located away from the parts that get the most heat and wear. That's why AO gloves can take plenty of punishment, too.

If you want to step up your welding production—and who doesn't these days—give AO gloves or mittens to *your* welders.

You'll find the Representative of your nearest AO Branch Office can help you choose the proper gloves and mittens from AO's welding line. Why not call him sometime today?

American Optical
COMPANY
SOUTHBRIDGE, MASSACHUSETTS



WHY THIS SQUARE FRAME WELDER DESIGN?

1. SIMPLER CONSTRUCTION — only two major parts, a rigid one-piece frame and husky rotating member. Single heat control. No complicated attachments. There is less to go wrong.

2. MORE COMPACT, EFFICIENT — it's entirely self-contained, self-excited, internally stabilized. The last word in simplicity, compactness, and ease of operation.

3. SAVES FLOOR SPACE — takes only a fraction of the area needed by conventional welders of equal capacity. Fits on shelf or under bench where desired.

4. A MORE FLEXIBLE WELDING SERVICE — double-decked with parallel connection, as shown at right, you have a much wider welding range.

5. REDUCES YOUR INVESTMENT IN WELDING EQUIPMENT — dual units with parallel hook-up eliminates the need for special high amperage machines.

6. WSR (Welding Service Range) Ratings give you the machine's actual delivered output — the *usable* welding heat from minimum to maximum.

7. Proved in more than 70,243,000 production hours in all kinds of plants — in all types of metal fabrication.

For complete information see your nearest P&H representative or write us.

General Offices: 4513 West National Avenue, Milwaukee 14, Wisconsin

HARNISCHFEGER CORPORATION
ARC WELDERS • EXCAVATORS • ELECTRIC CRANES P&H MOTORS • HOISTS • WELDING ELECTRODES

When machines are stacked and connected in parallel, one operator may have the combined welding capacity of two machines. Or, two operators have separate services, the equivalent of one machine each.

P&H manufactures a complete line of welding electrodes for both AC and DC use, including types for hard-surfacing, resistance to wear, impact, and abrasion as well as for all mild and alloy steel applications. Write for literature.

P&H ARC WELDERS

then he said to himself

"I'M SITTING TIGHT"

REPLYING to America's early proposals and assurances that the United Nations had no designs on Spanish territory, Dictator Francisco Franco defended his neutrality with:

> "I will avoid anything which might disturb our relations in any of their aspects."

Sitting tight in any business is one of the easiest things a man can do.

The only trouble is that in this era of quick advances, sitting tight doesn't get one anywhere—but down—and fast.

And when the dust of the passing parade clears—it's a long, plodding process to catch up.

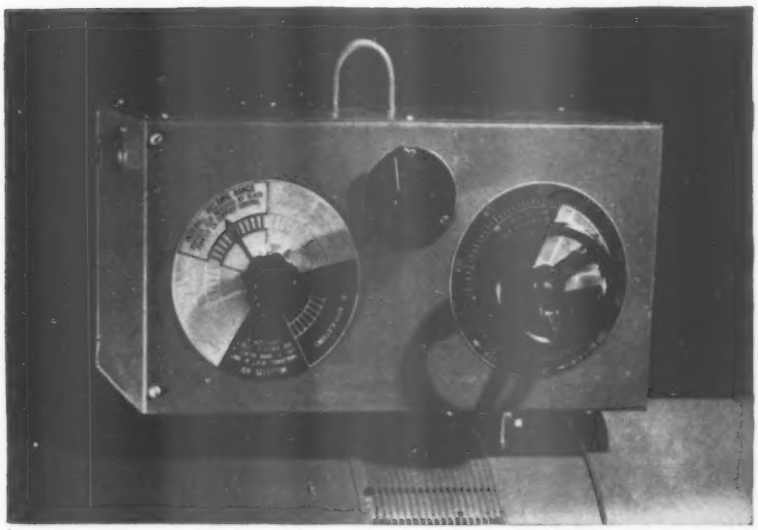
We see it well expressed in many "Stand pat" companies now making *no* plans for improving their welding methods—either in new production techniques or the latest welding equipment.

And others . . .

"SITTING TIGHT," *he says*

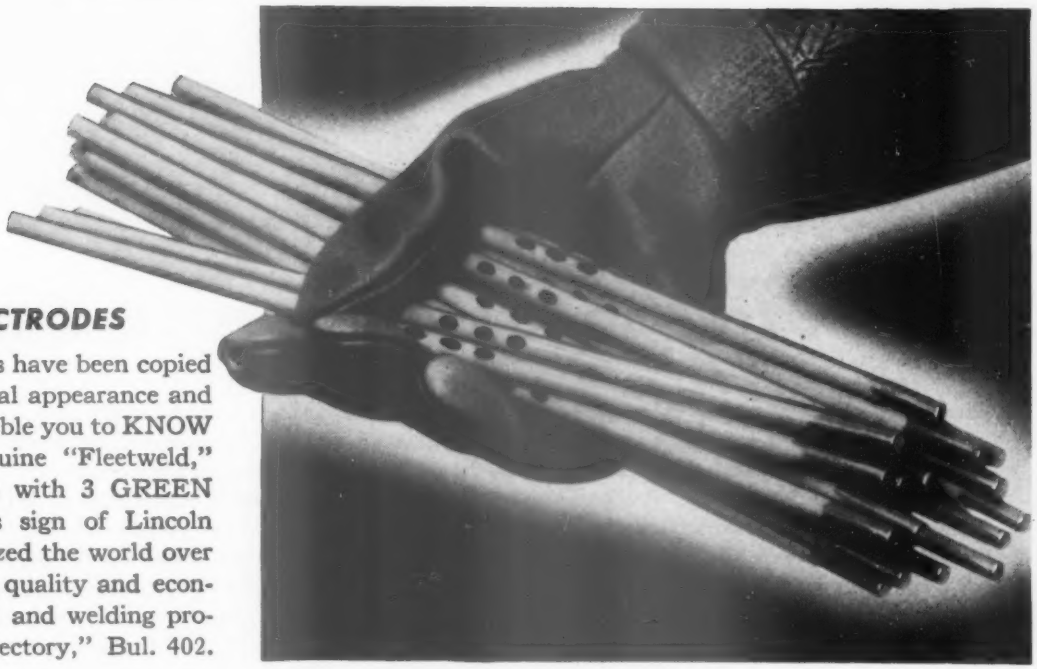
Look, Francisco . . . here is the wherewithal to step out in front with Arc Welding:

THE TOOLS FOR NON-STANDPATTERS



"SHIELD-ARC" WELDER

The "Job Selector" of the Lincoln "Shield-Arc" Welder permits selection of the TYPE of welding arc . . . a predetermined welding characteristic . . . to match the job. Its Current Control provides any desired amperage over a wide range. Both selectors are Self-Indicating for KNOWN results . . . unmatched speed, ease and economy of welding. The "Shield-Arc" is recognized the world over for its superiority 32 ways . . . described fully in Bul. 412.



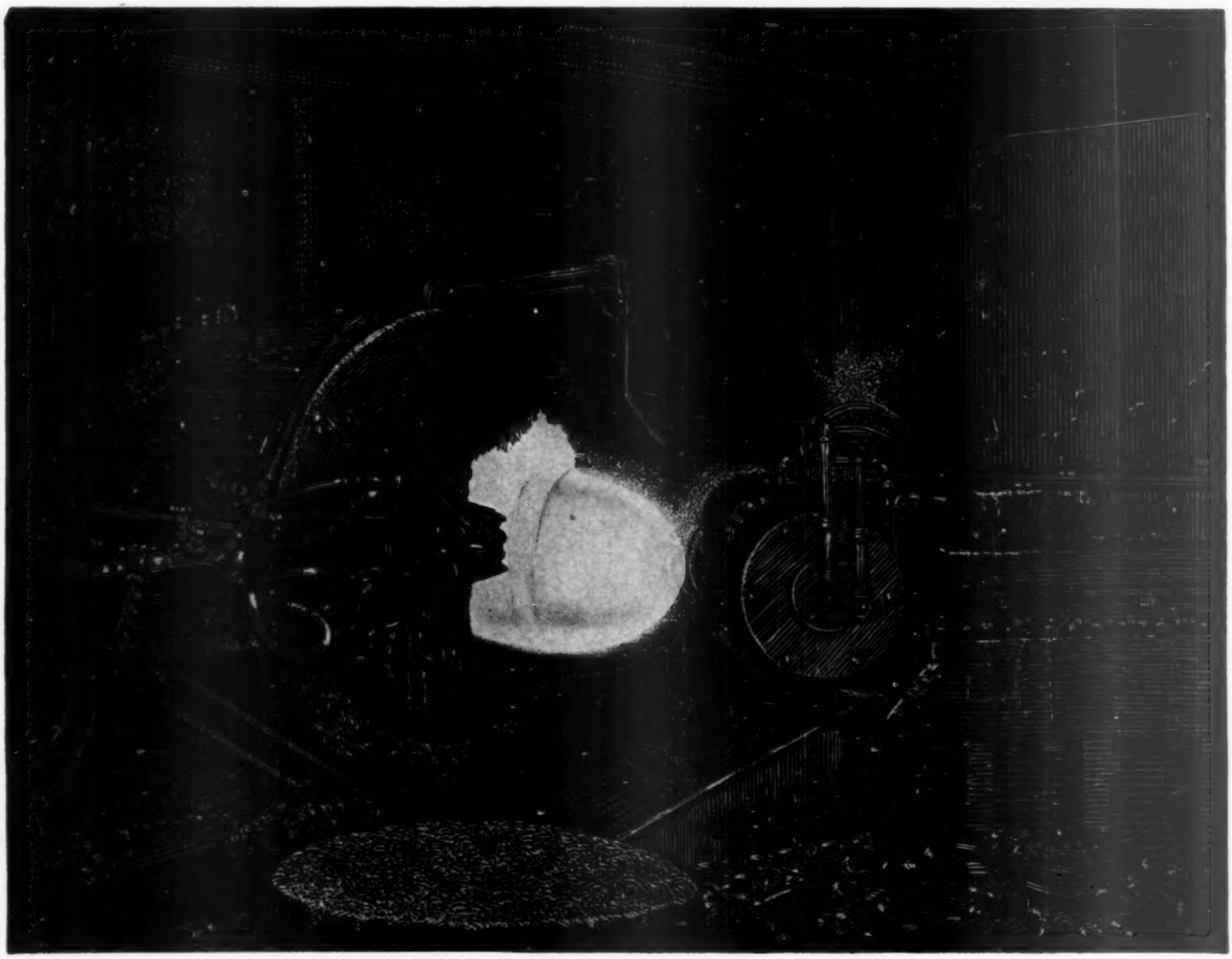
"FLEETWELD" ELECTRODES

These world favorites have been copied extensively as to general appearance and color of coating. To enable you to KNOW that you get the genuine "Fleetweld," they now are marked with 3 GREEN DOTS. Look for this sign of Lincoln Electrodes . . . recognized the world over for their superiority in quality and economy. Complete details and welding procedures in the "Weldirectory," Bul. 402.

THE LINCOLN ELECTRIC COMPANY • CLEVELAND 1, OHIO

America's greatest natural **recourse**

ARC WELDING



Flame Spinning "BLITZ BUNDLES"

Forming the ends of tubing for war and peace-time products is performed on a fast production basis by use of Airco's modern flame-spinning process. This method is now being successfully used on tubing ranging from 1/2" diameter up, with almost no maximum or minimum limit on the tube sizes that can be formed.

Here, for example, is shown the method used to form the nose section of an aerial bomb. The white-hot tube is whirled in a chuck and a uniform temperature is maintained by Airco oxyacetylene torches equipped with multi-flame heating tips. Forming is accomplished by bringing the heated end of the tube in contact with a forming roller, which is manipulated through remote control. This localized supplementary heating facilitates forming and, together with the spinning action, provides the necessary increase in the wall thickness of the formed section of the tube.

Flame spinning offers many practical advantages in speed, simplicity and economy. It is now being used on an increasing scale for shaping war products such as bombs, grenades, shock-absorbers, and many others. Its future application in metal parts fabrication promises to be even more widespread.

For complete details on this modern flame process and technical assistance in its application, call or write your nearest Airco office, or write to Dept. WE New York Office.

★ BUY UNITED STATES WAR BONDS ★

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The Welding Engineer

AMERICA'S PIONEER WELDING JOURNAL

Established 1916

Easy Money

The dawn of the new year finds us still at bitter war. Our hopes are high, however. Despite set-backs, the indications are that at least the "little half" of the job (the European phase) should be finished by mid-summer. Then we will be able to concentrate on the big job in the Pacific theatre so as to finish it as quickly as possible.

The war has not yet reached the stage where postwar plans can be put into operation, but it is wise to do some postwar thinking. Some persons engaged in the trade of welding seem to be getting confused in their thoughts of the postwar era. They appear to think that present conditions will continue after the war ends.

Some weldors, for instance, are prone to forget that the jobs on which they are working are cost-plus jobs—jobs on which speed is more important than cost. Consequently they can "soldier on the job." A few—relatively few, fortunately—practically get away with murder and brag about the corpse. So perverted are their values, they will actually boast about how much they are making for the little they do. "Let the war go on," they say. "I am making good dough and paying my way."

They are not paying their way. It is even doubtful if they are lending their way by buying war bonds. Because of their don't care attitude, brave men are paying in needless blood. There simply aren't words—at least polite ones—to say what we really think about such "soldiers" of the production line so we'll merely point out that these weldors are making their postwar plans, if any, along the same lines. They are looking for big pay and little work.

In the postwar period, emphasis will have to shift from the pay to the work angle. Just a little work won't be enough. When the undersigned was in the shop six or eight years ago, it wasn't considered anything out of the ordinary for a weldor to lay 300 to 400 feet of 3/16 inch bead downhand in an 8-hour shift. Weldors knew they could do that much, and they expected to. Recently I visited a shipyard where 30 feet of 3/16 inch downhand constituted a day's work. Just compare these two sets of figures! If wages remained the same, the cost of welding would have increased ten times at this shipyard, but wages have gone up too, so—well you figure it.

It all adds up to this: Can we expect fabricators in the postwar period to use welding with such a cost handicap? One answer might be the comparatively large number of green weldors working today. When jobs again get competitive because there are more weldors than jobs, weld footage per day will go up again, oldtimers say. It had better. Competition might get even tougher than weldors contemplate if the price per foot of welding becomes sufficiently high. There might be competition from rivets, bolts and other joining methods.

Weldors have sometimes scared fabricators out of using welding in the past by pointing out "the difficulties involved," "the time it would take," etc., and by being generally temperamental. It won't work any more. Weldors who start slowing down production in order to string out the jobs they are working on will soon find themselves no longer employed. It has happened in the past, and it can happen again. Managements aren't going to expect a man to work himself to death, but they are going to insist upon an honest day's work for a day's pay.

Easy money won't be here after the war ends. But welding will. And it will still go on paying a good living to the men who are willing to do their part to keep it the most effective and most economical metal-joining process.

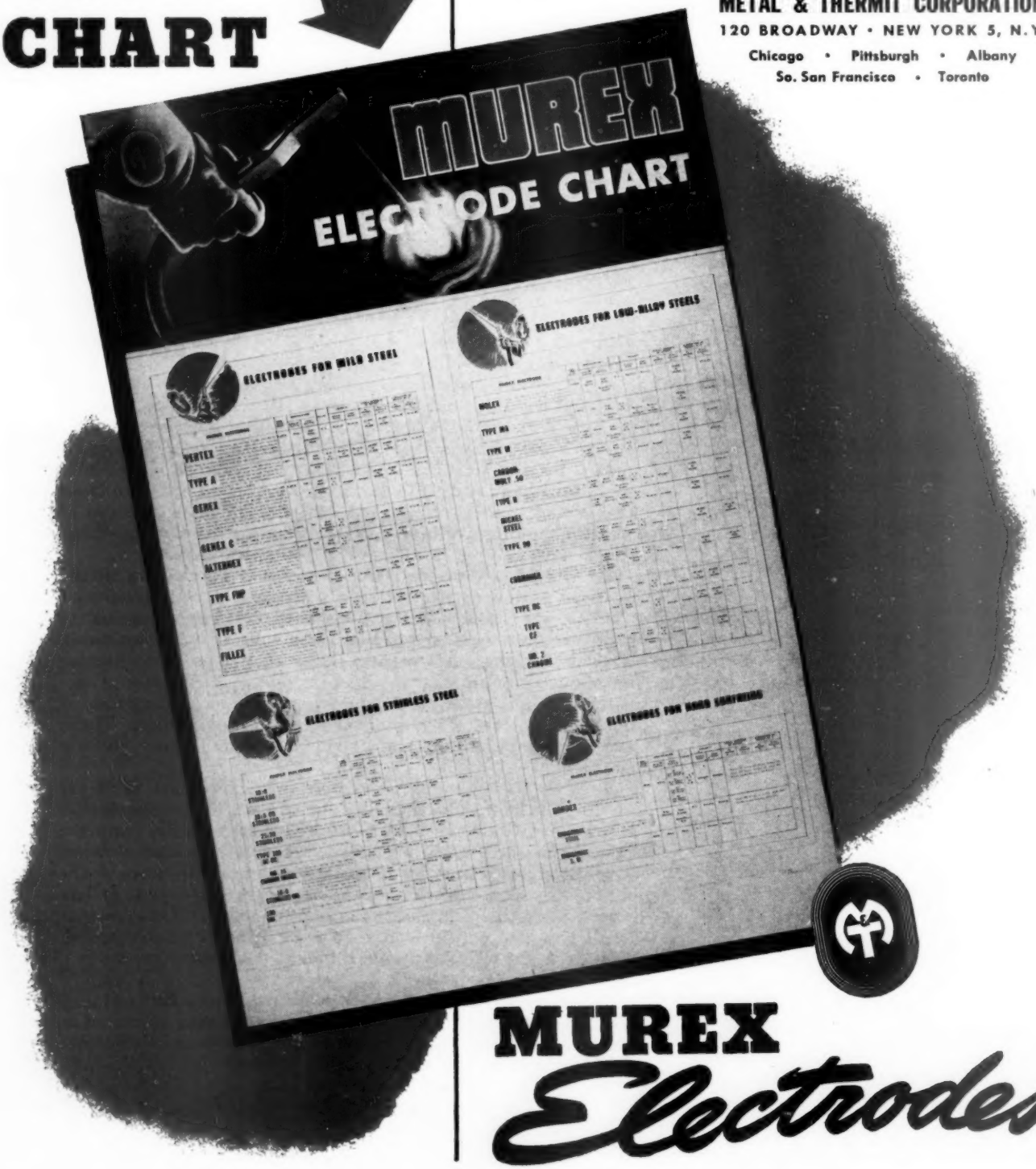
New MUREX WALL CHART

A helpful guide to selecting the right Electrode for the job

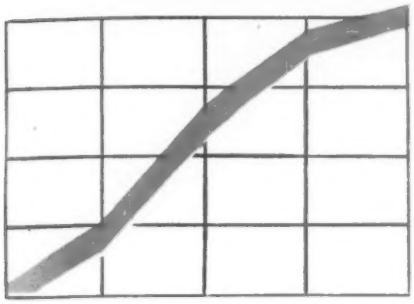
This new chart, just off the press, contains a complete list of Murex Electrodes divided into four groups for quick reference; mild steel, special steels, stainless steels and hard surfacing. Electrodes are described according to AWS-ASTM class. Color identification, recommended current strengths, polarity, and physical properties are also given. In addition, there are brief descriptions of the electrodes' general characteristics and applications.

The chart is 24" x 37", printed in four colors.

Copies will be sent free to those who request them on their company letterhead.

METAL & THERMIT CORPORATION
120 BROADWAY • NEW YORK 5, N.Y.
Chicago • Pittsburgh • Albany
So. San Francisco • Toronto

MUREX *Electrodes*

1944—Production Reaches Peak



Though the production of war materiel has not slumped, a leveling off from the peaks of the past year is apparent. The welding industry continues to make progress in research. Among the most promising of the new developments are multiarc welding, electronically controlled flame-cutting and storage-battery resistance welding.

By **T. B. JEFFERSON**

IN THE early years of the war the welding industry was busily engaged in production to meet war demands. Production was increased several fold, and countless technical problems were licked during the process. With the coming of 1944 it was found that the demand for welding machines, welding apparatus and welding electrodes had finally reached its peak and was beginning to level off. Relieved somewhat from the exigencies of continually expanding production, the welding industry could again devote a portion of its energies to the release of the new ideas developed during these war years.

All phases of the industry have been benefited by research, and some of the developments which have come recently to the front will undoubtedly have marked effects on the welding applications of future years.

Welding at War

While welding has played a most important part on the home front in producing for war, its rôle on the fighting front has been equally as effective. Landing barges especially fitted with welding and machine-shop equipment were among the first wave of ships that invaded the Normandy beachhead. These floating welding shops kept damaged equipment repaired while our ground troops were invading France. After beachheads had been established, some of this maintenance equipment was moved forward where it continued to do its job of repair right up to the front lines.

On all fighting fronts welding has proved itself indispensable. Many of our remarkable gains in the South Pacific would have been impossible without the welding and cutting equipment which permitted almost immediate repairs to be made to tanks, aircraft, guns, ships and to the bulldozers and other earth movers engaged in building airports. Behind the lines, welding and its allied processes have been extensively used for reclamation. Among specific uses may be mentioned the repair of docks, bridges and railroad facilities so that additional supplies could be rushed with minimum delay to hard-pressed fighting men.

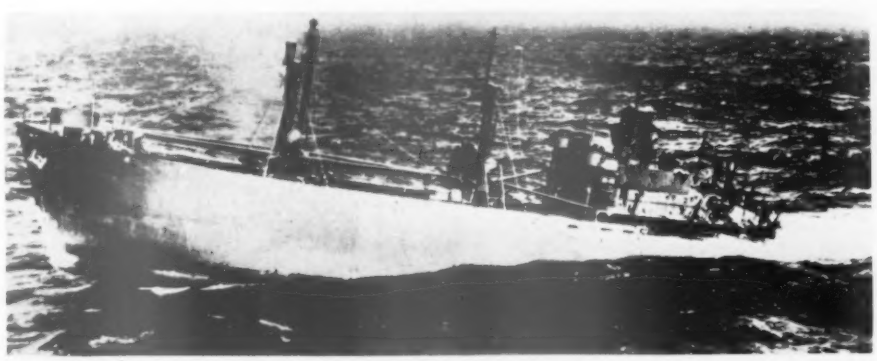
Underwater Welding, Cutting

When the full story is told of the part that welding has played in this, the greatest of all wars, we will find that underwater welding and underwater cutting have been perfected to a high degree as a result of their wartime uses. These two processes have made it possible to salvage many ships which would have been abandoned in other years because of their remoteness from drydocking facilities. Valuable lives have been saved because holes due to torpedos could be plugged before the ship sank. While underwater welding cannot satisfactorily substitute for surface welding, torpedo-damaged hulls can be and are patched by this process so that they will remain afloat long enough to make port safely.

Underwater cutting first assumed importance at Pearl Harbor, where it was responsible for saving the lives of many valiant men trapped in the hulls of capsized war ships. Days after these ships had turned on their sides or with keels to the sky, divers with underwater cutting torches were able to bring men to the surface alive.

While our fighting forces were thus learning new uses for underwater welding and cutting, our research laboratories on the home front have been busy developing new ideas. Some of them have been put into production so fast that the researchers have not had time to announce their brain children. For this and reasons of security, the subject is shrouded in mystery for many who are otherwise well informed on the progress being made in the industry. Few, for instance, realize that oxy-hydrogen and not oxy-acetylene cutting is employed beneath the surface of the sea or that metal-arc cutting has proved to be an even better method. Waterproofed electrodes with a hollow core are used, and a stream of oxygen is forced through the central hole in the electrode to supplement the cutting effect of the arc.

Wartime demands have presented a continuously changing picture dur-



Official U. S. Navy Photo, Courtesy The Lincoln Electric Co.

Welded ship construction has proved its worth under the severest of conditions. This picture shows the all-welded Liberty ship, "Ann Hutchinson," after being torpedoed off South Africa. Contrary to the evidence of the picture, the ship is still afloat and busily engaged in her task of delivering war supplies to one of our fronts.

Signal Corps Photo

Though it is well known that arc welding and oxy-acetylene welding are employed by the U. S. Army when on the march, it seems strange to think of the Army carrying along heavy resistance-welding machines. Yet that is just what was done in North Africa, as this picture of a spout being welded to a water can shows.

ing the past year of military accomplishment. For instance, the production of tanks was cut back early in the year while impetus was given to the landing-craft program. This naturally resulted in changes in the welding market.

Important changes in shipbuilding also occurred. That faithful old standby the Liberty ship is gradually being replaced by the faster Victory, a ship designed to compete in postwar commerce as well as to serve as a war transport. The speedier, streamlined Victory is much more nearly an all-welded vessel than even the Liberty.

Despite the greater demand for welding on the Victory, production is slower. Hence this drastic change in the shipbuilding program has so far given little indication of any changes in the overall effect on the welding industry.

Welded Ships Okayed

Alarmists, sensationalists, advocates of the "good old ways" of doing things, uninformed newspaper correspondents, and apologists for welding generally received a severe setback in the published report by the Maritime Commission formally endorsing welded ship construction. Despite all the scare stories of welded ships breaking in two, the truth is not nearly so bad as the general public had been led to believe, the Maritime Commission revealed. Up till April, 1944, some 3,000 welded ships had been launched, of which only 95 developed cracks. Of these 95 only six ships broke in two or cracked to such an extent that they had to be cut in two in order to be salvaged.

Net losses in ship tonnage were not even this serious. Of the six ships which failed, five were towed to port, rewelded and put back into service. The remaining ship lost only its bow section; this bow section, deemed not worthy of salvage, was purposely sunk on the grounds that it constituted a hazard to transportation in North Atlantic convoy lines.

To summarize, it can truthfully be said that of some 3,000 ships built by welding, only ½ a ship (the bow section referred to above) has been lost because of structural failures that can be attributed to defective welding. This is an excellent record, and especially so when you consider how important welded ship construction has been to our effort to overwhelm the enemy in both Europe and the Pacific.

More Women Weldors

The past year has seen a continuation of the program to provide skilled help by training we'ding operators. Women have made up an increasing percentage of the trainees because of Selective Service's continuous demand for the young men who would normally be taken. The demand for additional weldors was partly because of expanded uses of welding and partly because Selective Service for reasons of its own continues to take skilled weldors from war production and put them in the armed forces. The only way to meet the situation has been to call in more women and train them to weld.

All things considered, the woman weldor has proved herself to be a most acceptable substitute; however, she is unsuited to certain heavy fabricating jobs because of the weight lifting involved. Various conveyor and hoisting systems have been adopted by many plants to overcome this difficulty and allow women to do real he-man's work.

During the flush of optimism which swept over the nation in midsummer of 1944, the welding industry began to formulate its thinking of what the postwar picture might ultimately present. There was considerable discussion of reconversion and some practical planning was done. The outlook, it should be noted, is quite bright for postwar welding, for industries that have learned to use this process on their war contracts have indicated that they will continue to demand this superior metal-joining method . . . After permitting us this brief glimpse of the coming sun, the war clouds closed again. The Nazis continued their stubborn defense of the Siegfried line, the War Production Board revealed that it had grossly underestimated the amount of ammunition that would be necessary to defeat them, and all plans for reconversion had to be shelved.

Sales Trends

The consumption of oxygen and acetylene for welding and (particularly) cutting purposes has continued to grow. Flame-cutting has become our most important means of severing steel for fabricated construction. The sale of arc-welding machines has also increased, but the sale of welding electrodes will probably show a drop of some 35 to 40% from 1943 levels. Since electrode production reached 1,086,784,300 lb in 1943, the 1944 production will therefore be between 650,000,000 and 700,000,000 lb—a not inconsiderable amount of welding electrodes.

In some localities the sale of arc-welding equipment is reaching an all-time peak. This fact is rather difficult to explain, but it may be due to one or more of the following reasons:

1. In the earlier war years certain localities were not able to meet the demand for welding equipment because of the low-priority type of work being handled.
2. Much of the equipment used in war plants, arsenals and shipyards has been worn out and has had to be replaced.
3. Individual weldors have begun to do postwar planning of their own and are now ordering equipment in anticipation of going into business for themselves when they no longer have war jobs.

New Developments

During the past year there were many new developments in all phases of welding. A few of them which have resulted in improved techniques or better production methods are worth recalling to memory.

Experimentation continued with inert-gas-shielded arc welding, using both helium and argon gases. This process, though originated to permit the welding of magnesium alloys, has been found to be equally satisfactory for aluminum alloys and stainless-steel materials. The technique is very similar to oxy-acetylene welding, and skilled gas weldors do the best work with inert-gas-shielded equipment. The process has been put to many practicable uses in our war plants, particularly in those engaged in the production of military aircraft.

Another development that has found application in aircraft plants is multiple-arc or multiarc welding.

This process was developed to make possible the arc welding of relatively thin sheets of aluminum alloy. It is similar to the inert-gas-shielded process and to atomic-hydrogen welding in that the arc weldor is required to use both hands. The multiarc process necessitates the use of a twin-carbon torch in one hand and an electrode holder with a heavily coated metal-arc electrode in the other. Two sources of welding current are needed: an a-c source to supply the twin-carbon arc torch (necessary because it results in an even burn-off of the carbon) and either an a-c or d-c source for supplying the metal electrode.

The chief advantage claimed for this type of welding is that it permits the delivery of a large amount of heat in a concentrated form and under perfect control to the surface of the material being welded. The heat transfer and temperature are such that the parent metal receives a preheat while the weld deposit acquires a postheat. All gases and impurities are allowed to escape to the surface of the molten metal before it becomes sufficiently plastic to entrap them and so cause porosity.

Automatic-Welding Innovations

Electronic controls have been introduced to automatic arc welding in order to simplify some of the problems encountered in automatic set-ups —especially where short runs or extremely thin metals are involved. And while we are in the field of automatic welding, 1944 also saw the introduction of a d-c submerged-melt welder. This machine is in many respects similar to the well-known a-c submerged-melt welder, the principle difference being that it uses a d-c power source.

Users of welding have learned much of the deep-fillet welding technique through the promotional efforts of important equipment manufacturers. Larger electrodes (¼ in. and over) are employed in deep-fillet welding. With this new technique and a hot rod (AWS E-6020), welded products can be turned out faster than ever before.

To meet the war-stimulated demands for high-strength, heat-resistant and corrosion-resistant materials, steel mills have developed many new alloys and alloy-clad materials which present new problems to welding. One of the most unusual instances was the use of silver-clad steel in the building of acid dehydration columns. Though preliminary studies had given the industry the correct technique, considerable ingenuity was needed in order to do the actual job. The mild steel backing was welded with a metal arc, and the atomic-hydrogen process was employed with a silver filler rod to join the 99.9% pure silver cladding.

Electronic Flame-Cutting

One of the year's most amazing uses of electronics in the welding industry was an electronically controlled flame-cutting machine developed on a radically different principle—one similar to that of the electronic phonograph. This new machine is guided by plastic cylinders which are scribed from blanks by simply guiding a pointer along the outline of a full-size or reduced-scale drawing. The scribed marks are inked in, and the "record" becomes the template for flame-cutting operations. The plastic cylinders are not affected by changes in temperature or humidity, and they may be reused and stored indefinitely. Unlike phonograph records, they cannot wear out since the cylinder markings are scanned only by a beam of light. A photo-electric brain senses the findings of its "light eye" and orders the instructions for cutting.

Another 1944 development was the extension of oxy-acetylene pressure welding to pipe lines. Designed primarily for the welding of railroad rails, this process had hitherto been used only experimentally on other applications. Last year, however, the equipment was taken into the field to weld pipes of large diameter in the construction of natural-gas pipe lines. It could be used, of course, only where the runs were straight and comparatively level. Though reports are not wholly in agreement, the process appears to offer many possibilities for this particular application. Any new developments will be looked forward to with interest.

Storage-Battery Welding

To the resistance-welding field, 1944 brought the reintroduction of the storage-battery-powered resistance welder—this time on a practicable basis. Welders of this type were developed ten to twelve years ago but dropped because of unsatisfactory batteries. War stimulated the development of better batteries and so assured the success of storage-battery welding. The contactor-control used in this type of equipment is another wartime development that was necessary to make the storage-battery-powered welder a success.

Battery-powered equipment should offer unlimited opportunity for the establishment of spot and other forms of resistance welding in localities where adequate facilities are not available for heavy power demands. Storage-battery welding can be done wherever the welding machine and a small home-lighting plant can be taken, claims the manufacturer of this equipment.

This brief summary by no means covers the welding research that has come out of the war. We have learned much about the welding of different materials, and many jobs once deemed "impossible" can now be handled with the aid of the welding arc, the welding torch or the cutting flame. It should be noted, however, that welding applications, for the most part, have been devoted exclusively to the business of war. When researchers are again allowed to release their full creative energies to peacetime applications, we will undoubtedly see many astounding new developments.

Flame-cutting has become our most important means of severing metals. This G. I. is cutting a piece of tin with an oxy-acetylene torch, somewhere in Iceland.

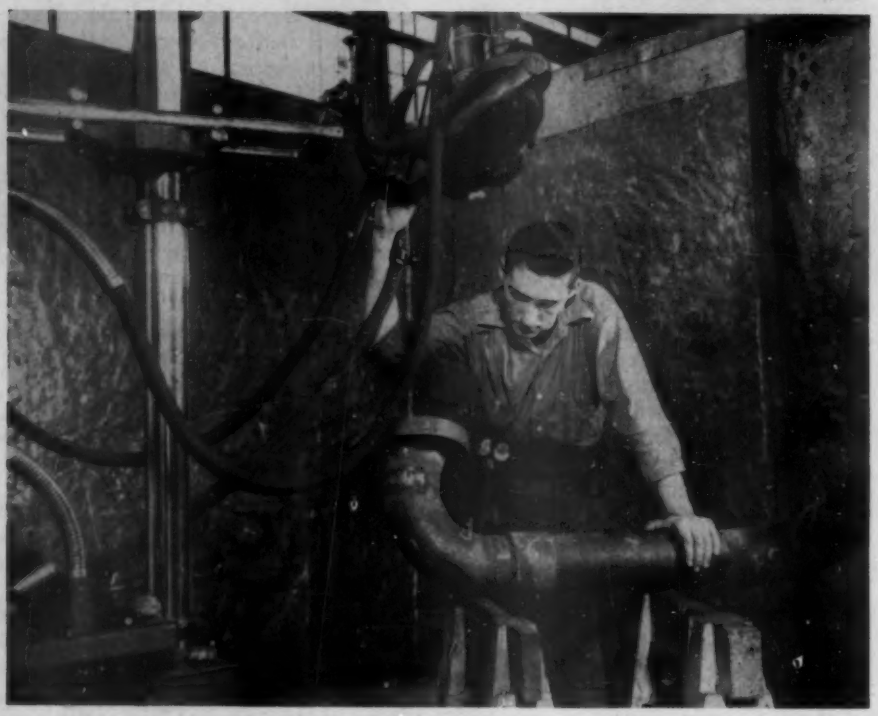
Signal Corps Photo

★ INSPECTION

Better Battleships

Speeding the day of our final reckoning with Tokio, X-ray inspection assures perfect welds and castings for our fighting ships and helps navy yards to send superb new naval units to sea in record-breaking time.

An electron is the smallest particle of matter: so small that 30,000 trillion trillion weigh less than an ounce. Yet these tiny electrons are today speeding the construction of battleships and other naval vessels.



This operator is positioning the tube of a 140,000-volt industrial X-ray unit preparatory to inspection of a pipe weld at the New York Shipbuilding yard at Camden, N. J.

Protected against stray radiation within a lead-lined booth, this operator is adjusting the controls of a 140,000-volt unit prior to X-raying welds in a steam pressure pipe.

At the big Philadelphia navy yard and at the New York Shipbuilding Corp. yard nearby, electrons are playing an important role in seeing that American sea-fighting equipment can take it in battle. How do they do this prodigious job? The answer is: by X-ray!

X-rays are produced when electrons, millions and millions of them, strike a metal target at terrific speed. The rays that are given off penetrate solid substances and produce a shadow picture on photographic film. The developed film shows up any defects in the subject that has been X-rayed.

Higher Voltage, Harder X-rays

To get more and more penetrating X-rays, voltages are increased. The super-detective at the $25,000,000 Philadelphia navy yard is General Electric's compact million-volt industrial X-ray unit. The rays produced by this machine can penetrate 8 in. plates of steel and can inspect in 16 minutes sections of metal that previously required 60 hours. Yet even this is not the largest. Last month THE WELDING ENGINEER (page 88, November issue) told of the development of a two-million volt unit that will make a satisfactory exposure through a foot of solid steel in about two hours. Thus do we progress!

The million-volt unit is less than 5 ft high by 3 ft in diameter and weighs about 1,500 lb. Located in a building adjacent to the navy-yard foundry, it is used principally to inspect steam pressure castings which weigh from 150 to 2,000 lb. It readily detects cracks, tears, sand and gas cavities. Unlike destructive methods of inspection such as sectioning or the sawing apart of a piece, radiography provides information without damage to the piece being inspected.

The position of a defect such as inclusion of slag is shown by the radiograph, as the film is called. The casting is sent back to the foundry, and the defect is chipped out. New metal is welded in, and the part is again X-rayed. If it is then satisfactory, the machining of the casting is completed.

with X-rays

By JOHN L. BACH
General Electric X-ray Corp.

X-ray units at the Philadelphia navy yard are used principally for the inspection of welds in high-pressure pipes. The 12 in. main steam line on the right has eleven welds to be checked radiographically. Inspectors estimate that on a battleship there are 1,800 vital high-pressure pipe welds, all of which must be X-rayed.

To speed up the inspection process t the Philadelphia navy yard, about 0 castings, weighing 200 lb each, are et in a circle around the target of the illion-volt unit, and all are radiographed simultaneously with a two-minute exposure. The reflected beam, prayed out for the full 360 degrees

This operator at the New York Shipbuilding yard is checking the position of a 250,000-volt industrial X-ray unit before radiographing a heavy valve casting.

around the tube, penetrates all of the parts to be examined and records a shadow picture on the film previously positioned behind each part. All of the 20 castings are inspected in two minutes.

The X-ray giant also inspects big plates of armor steel, 5 inches thick, for ships' hulls. X-ray does the inspection job on these plates in 10 minutes, whereas gamma rays from radium, the only other method that could be used, would take four hours.*

Three smaller X-ray units are also used at the Philadelphia navy yard for inspection work. At the New York Shipbuilding yard, Camden, N. J., three similar units are used for practically the same type of work.

Philadelphia Navy Yard

The Philadelphia yard, which has built eight different types of naval vessels since the outbreak of the war, uses a 220,000-volt and two 140,000-volt portable X-ray units to inspect welds in high-pressure pipes used to carry steam from one end of the ship to the other. It is estimated that there are 1,800 vital high-pressure pipe welds on a battleship, and all of them are examined by X-ray. The pipes are of various thicknesses and range from 3 to 12 in. in diameter. An average of four exposures is made to X-ray each weld, the exact number depending upon the diameter of the pipe.

"Steam pressure welds must be perfect," one inspector said, "because there is so much at stake. If a defective weld gave way while a ship was in a combat area, the results might prove fatal to both ship and crew. Or if a defective weld gave way at any time, the lives of the entire crew would be endangered by scalding steam. It is our job to spot defects before they can do any damage, and we like X-rays because we are able to obtain better definition and more contrast in pictures of the defects."

X-raying Glider Hooks

Both of the 140,000-volt portable units are used on a wide variety of inspection jobs. One of these is the X-raying of cast-steel hooks which are fastened to planes for the towing of one or more gliders.

"These glider hooks," an inspector said, "must be absolutely flawless because a defective hook would hardly stand the pull of three gliders."

Each hook weighs 15 lb, and ten of them undergo X-ray exposure at the same time. The exposure requires only one minute; the entire X-ray inspection job, from the time the exposure is made until the films are viewed by girl inspectors, can be done in about 20 minutes. Heavier hooks, weighing 25 lb, are often inspected with the million-volt unit, and 16 of them can be examined in two minutes.

One of the 140,000-volt units is small enough to be taken into the hold of a ship to inspect the final connecting welds on high-pressure piping after it has been installed.

New York Shipbuilding Yard

At the New York Shipbuilding Corp. yard, which turns out battleships, cruisers, aircraft carriers and hundreds of the larger types of landing craft, a 220,000-volt X-ray unit is used to inspect big turbine castings, pipe welds, turret parts, and bronze and brass evaporator castings, the latter an integral part of equipment for transforming salt water into drinking water.

Wherever ships are built—whether at Philadelphia, Camden, Norfolk, Boston or San Francisco—industrial X-ray units stand guard along the inspection lines . . . speeding the day of victory by sending ships to sea in record time.

The workman is positioning a 200,000-volt tube head for the inspection of welds in a heavy-walled high pressure steam pipe. The cone attached to the head confines the X-radiation.

* Though slower than X-rays, gamma rays possess great penetrating power. Up to 11 and 12 in. of steel have been traversed by gamma rays.—The Editors.

Fabrication Cost vs. Width*

★Part One—To build the shell of a pressure vessel, which is more economical: a one-piece fabrication of a wide plate or a two-piece fabrication of narrower plates? The answer is given in this two-part article.

By **DR. W. G. THEISINGER**

Assistant to Vice-President, Lukens Steel Co.

BOILERS, pressure vessels and similar structures may be built of plates formed as illustrated in Figs. 1 and 2. Fig. 1 shows a drum with length equal to or greater than its circumference and Fig. 2 a vessel of circumference equal to or greater than its length. A single plate may be employed in either type of assembly provided that the shorter dimension does not exceed 195 in. (approximately the maximum width of steel plate obtainable). In such a case, all of the fabricating operations are confined to just one plate, which, however, is generally of a width in excess of 100 in. and so subject to a "width extra" charge in addition to the base price.

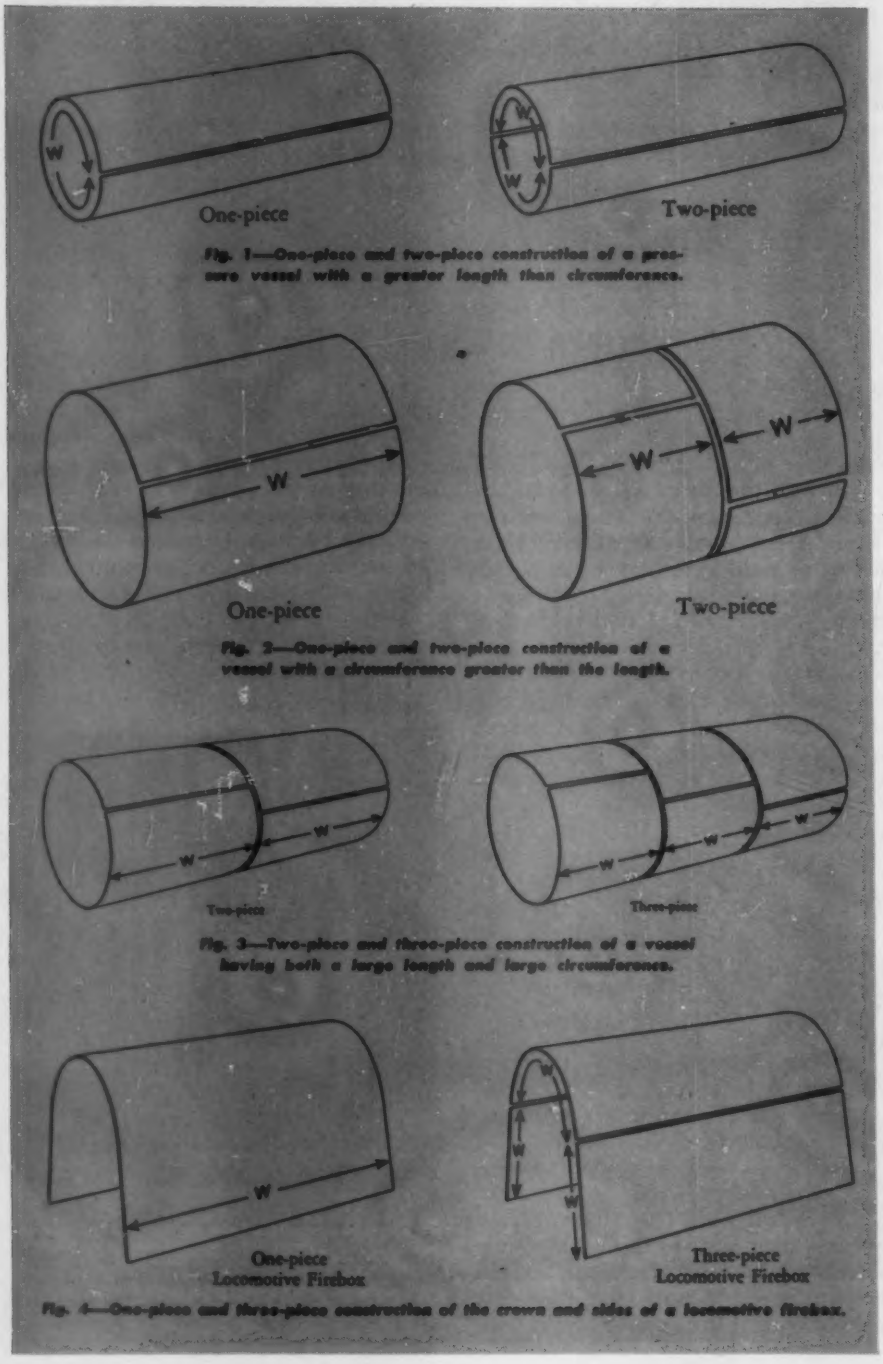


Fig. 1—One-piece and two-piece construction of a pressure vessel with a greater length than circumference.

Fig. 2—One-piece and two-piece construction of a vessel with a circumference greater than the length.

Fig. 3—Two-piece and three-piece construction of a vessel having both a large length and large circumference.

Fig. 4—One-piece and three-piece construction of the crown and sides of a locomotive firebox.

Two-Plate Construction

To avoid width extras, two plates are sometimes used. This practice more than doubles the number of fabricating operations to produce the same shell. To determine whether one-plate or two-plate construction should be employed, the cost of the additional fabricating operations required should be compared with the higher initial cost of the one plate due to its width extra.

Vessels are also constructed as shown in Fig. 3. Here the circumference of the vessel is large, and its length exceeds the greatest available width of a single steel plate. In vessels of such construction, the widths of the plates used exert an important influence on fabricating costs. To determine whether two-piece or three-piece construction should be used, the fabrication cost should be balanced against the width extras involved.

An example is provided by the crown and side construction of a locomotive firebox, Fig. 4. In the one-piece construction, the length of the plate is the girth dimension and the width of the plate develops the length of the firebox. In the three-piece structure, the common length of the three plates becomes the length of the firebox. The one-piece type is a simple matter to lay out and roll; the three-piece construction necessitates the handling and forming of three

*Abstract of a paper, "Fabrication Costs of Boilers, Tanks and Pressure Vessels as affected by Plate Widths," presented at the annual meeting of the American Society of Mechanical Engineers, New York City, Nov. 27 to Dec. 1, 1944.

*Heating operations not generally required for plates under 1" thick.

Fig. 5—Flow sheet comparing the number of fabricating operations in the one-plate and two-plate shells shown in Fig. 2.

of construction must undergo a total of 53 operations, while fabrication of the one-plate type of vessel involves only 23 operations.

This reduction of more than 50% in fabricating operations by the use of the one-piece construction results in economies in fabricating cost, in fabricating time and in the man-hours required for fabrication. Of even greater importance to the fabricator is the possible increase in the plant's productivity (and hence in sales volume) without any expenditure for additional plant or machinery.

Costs of Unnecessary Operations

What are the costs of the additional fabricating operations made necessary by the use of the two-plate type of construction? To obtain reasonably accurate and reliable data on the cost of U-68 class construction, intensive studies have been conducted over a period of several years. Table I is a typical example of the costs for the extra operations required in the fabrication of a two-plate vessel, 2 in. thick. While fabricating costs are known to be higher today, the figures given represent a fair cross-section of the U-68 type of fabrication in normal times.

For comparison with the entire cost of the extra operations, the percentage relationship of each operation is given in Table I. It will be noted that the actual welding of the pieces as well as the welding and incidental operations.

53 vs. 23 Operations

The flow sheet, Fig. 5, compares the number of fabrication operations for the one-piece and two-piece shells sketched in Fig. 2. In the two-piece shell, the narrow plates are joined together by means of a circumferential seam in the middle of the length of the vessel. The welding of the extra circumferential seam is merely one item in fabricating cost. In addition, all other operations are doubled, including handling, laying out, trimming, beveling, heating, crimping the edges, reheating, rolling, assembling, cleaning, chipping, grinding and X-raying. Further extra operations required for the two-piece type are resquaring and beveling edges for the round seam and re-rounding the two courses and their fit-up. Altogether, the two-plate type

Table I. Extra Fabricating Costs* for Circumferential Seams, U-68 Construction, 2 In. Plate

Operations	*Extra Cost* per Ft. of Seam*	*Percent Extra Cost*
Layout	$ .42	2.21
Trimming	.60	3.14
Machining	.92	4.84
Heating and Crimping	1.50	7.89
Heating and Rolling	2.36	12.41
Shot-blasting	.22	1.16
Fit-Up	.84	4.42
Extra Welding Long Seam	.87	4.58
Clean, Chip and Grind	.29	1.53
Reround	.83	4.37
Resquare and Bevel	1.25	6.58
Fit-up	.83	4.37
Weld Circumferential Seam	5.60	29.46
Chip and Grind	.72	3.78
X-ray	1.76	9.26
	$19.01	100 00

** These cost figures include 133 percent shop burden, but not sales or administrative expense or profit. Shop burdens have been found to vary from 100 to 200 percent.*

Table II. Fabrication and Width Extra Cost per Ft and per 100 Lb, U-68 Construction

PLATE SIZE, IN.	TOTAL WEIGHT, LB	CIRCUMFERENTIAL WELDING				LONGITUDINAL WELDING			
		COST PER FT		COST PER 100 LB		COST PER FT		COST PER 100 LB	
		Fabrication	Width Extra	Fabrication	Width Extra	Fabrication	Width Extra	Fabrication	Width Extra
12 x 108 x ½	190.9	$ 8.51	$ 0.10	$ 4.46	$ 0.05	$ 6.81	$ 0.10	$ 3.57	$ 0.05
12 x 120 x ½	213.2	8.51	0.32	3.99	0.15	6.81	0.32	3.19	0.15
12 x 132 x ½	236.7	8.51	1.78	3.60	0.75	6.81	1.78	2.88	0.75
12 x 144 x ½	259.5	8.51	2.60	3.28	1.00	6.81	2.60	2.62	1.00
12 x 160 x ½	288.2	8.51	3.60	2.95	1.25	6.81	3.60	2.36	1.25
12 x 174 x ½	316.5	8.51	4.75	2.69	1.50	6.81	4.75	2.15	1.50
12 x 192 x ½	349.2	8.51	6.98	2.44	2.00	6.81	6.98	1.95	2.00
12 x 108 x 1	376.4	11.66	0.19	3.10	0.05	9.33	0.19	2.48	0.05
12 x 120 x 1	420.2	11.66	0.63	2.77	0.15	9.33	0.63	2.22	0.15
12 x 132 x 1	464.5	11.66	3.48	2.51	0.75	9.33	3.48	2.01	0.75
12 x 144 x 1	509.2	11.66	5.09	2.29	1.00	9.33	5.09	1.83	1.00
12 x 160 x 1	565.7	11.66	7.07	2.06	1.25	9.33	7.07	1.65	1.25
12 x 174 x 1	618.2	11.66	9.27	1.89	1.50	9.33	9.27	1.51	1.50
12 x 192 x 1	682.2	11.66	13.64	1.71	2.00	9.33	13.64	1.37	2.00
12 x 108 x 2	752.8	19.01	0.38	2.53	0.05	15.21	0.38	2.02	0.05
12 x 120 x 2	840.5	19.01	1.26	2.26	0.15	15.21	1.26	1.81	0.15
12 x 132 x 2	929.0	19.01	6.97	2.05	0.75	15.21	6.97	1.64	0.75
12 x 144 x 2	1018.4	19.01	10.18	1.87	1.00	15.21	10.18	1.49	1.00
12 x 160 x 2	1131.2	19.01	14.14	1.68	1.25	15.21	14.14	1.34	1.25
12 x 174 x 2	1236.4	19.01	18.55	1.54	1.50	15.21	18.55	1.23	1.50
12 x 192 x 2	1364.4	19.01	27.29	1.39	2.00	15.21	27.29	1.12	2.00

extra circumferential seam costs $5.60 per ft or about 29.5% of the total $19.01 cost per ft of seam of the extra fabricating operations. This table shows that the one-plate vessel in 2 in. gauge can effect an economy in fabrication cost of about $19 per ft of seam, from which saving must be deducted the higher initial cost of the plate due to the width extra.

Translating Width Extras

Width extras for carbon-steel plates are quoted by the mills in costs per 100 lb. The fabricator generally estimates his costs per ft of seam per vessel. Naturally, it is difficult to compare two dissimilar figures such as the relationship between a width extra of, say, 5c per 100 lb and a fabricating cost of $11.66 per ft of seam. To overcome this confusion, it is desirable to translate the width extra per 100 lb into width extra per ft of seam or per ft of length of plate.

A simple example will show how to do this. Fig. 6 represents a 56 in. diameter vessel with a circumference of 176 in. and a shell length of 108 in. This vessel could be made from a single 1 in. plate, 108 in. wide and 176 in. long. The theoretical weight of the plate, including the maximum overweight allowance of 5%, is 385.5 lb per ft of length. The width extra is 5c per 100 lb for a plate 108 in. wide and hence 19c per ft of length of the plate. To justify the use of two plates, the fabricator would have to perform all of the extra operations required by the circumferential seam at a cost of 19c per linear ft or less.

A good average figure for U-68 fabrication in 1 in. thick steel plate has been found to be $11.66 per linear ft. Using the one-plate shell shown in Fig. 6, the fabricator saves himself a fabricating cost of $11.66 less 19c per linear ft—a net economy of $11.47 per linear ft. As the length of the circumferential seam is 14 ft 8 in., the saving of $11.47 per linear ft becomes $168.22 for the entire shell. The width extra was $1 per ton; the net fabricating cost saved by paying it amounts to $59.50 per ton.

Converted to other units, the fabricating cost of $11.66 per ft becomes $3.025 per 100 lb. Thus the one-plate construction saves the fabricator the difference between the width extra of 5c per 100 lb and his additional fabricating cost of $3.025 per 100 lb —a saving of $2.975 per 100 lb or $59.50 per ton.

Cost Data Simplified

In Table II are given fabrication costs for U-68 construction, per ft and per 100 lb, for circumferential and longitudinal welding as well as the width extras per ft and per 100 lb for plate of several gauges and widths. Examining this table, we quickly see that for ½ in. plates, regardless of width, the width extras per ft or per 100 lb never equal the corresponding fabrication cost for circumferential welding. Consequently the wide plate is always justified for the fabricating costs given. With ½ in. plate 192 in. wide, for example, the width extra per ft in circumferential welding is $6.98 compared with a fabricating cost of $8.51 per ft; on the per 100 lb basis, the width extra is $2 while the fabricating cost is $2.44.

For a 1 in. thick plate, width extras and fabrication costs balance at width of about 185 in.; for a 2 in. plate at about 176 in. The thickness of the plate must always be considered in determining the optimum plate width and the calculations for any given gauge cannot be directly applied to other gauges in the same width.

These fabrication costs are acceptable averages for U-68 construction, but the costs will naturally differ for other grades of construction; for these grades the fabricator should compute his own fabrication costs, being careful to include all items shown in the fabrication procedure of Fig. 5. The cost figures can, of course, be eliminated on operations not employed; X-raying, for example, is not required on U-69 work.

Quick Comparisons

Fig. 7 puts in nomographic form the data of Table II. The width extras per 100 lb for widths over 100 in. are shown in the form of steps. Fabrication cost per 100 lb for the two-piece construction by circumferential welding is shown for gauges from ½ to 4 in. inclusive.

The use of Fig. 7 is illustrated by the following examples:

A two-piece construction by circumferential welding of a shell 144 in. long and 1 in. thick requires two plates 72 in. wide. As shown by the intersection of 144 in. with the 1 in. gauge curve, the extra fabrication costs $2.30 per 100 lb ($11.66 per ft). One-piece construction from a plate 144 in. wide is seen to involve a width extra of $1 per 100 lb. The one-piece construction, therefore, will save $1.30 per 100 lb in fabricating cost or $26 per ton of steel plate.

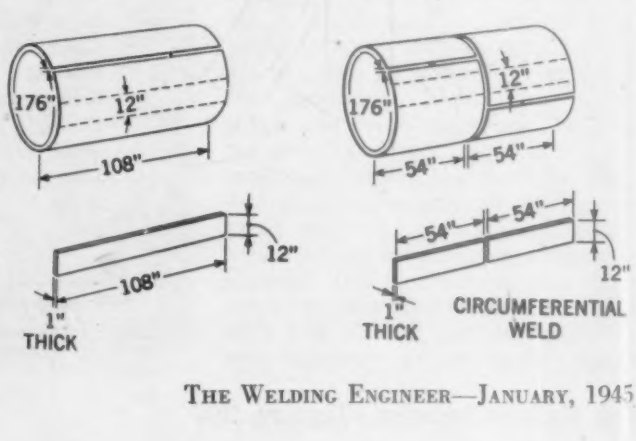


Fig. 6—One-piece fabrication of this vessel from a plate 108 in. wide will result in a net economy of $168.22.

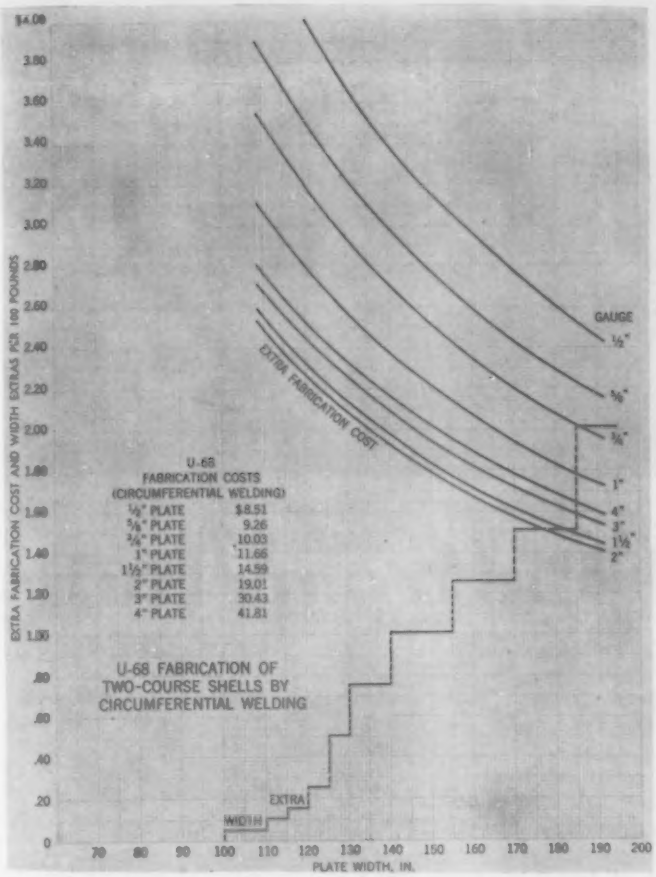


Fig. 7—Nomograph based upon the data given in Table II. Find plate width on horizontal scale, follow vertically to intersection with the required gauge curve and then horizontally to fabrication cost and width extra scale.

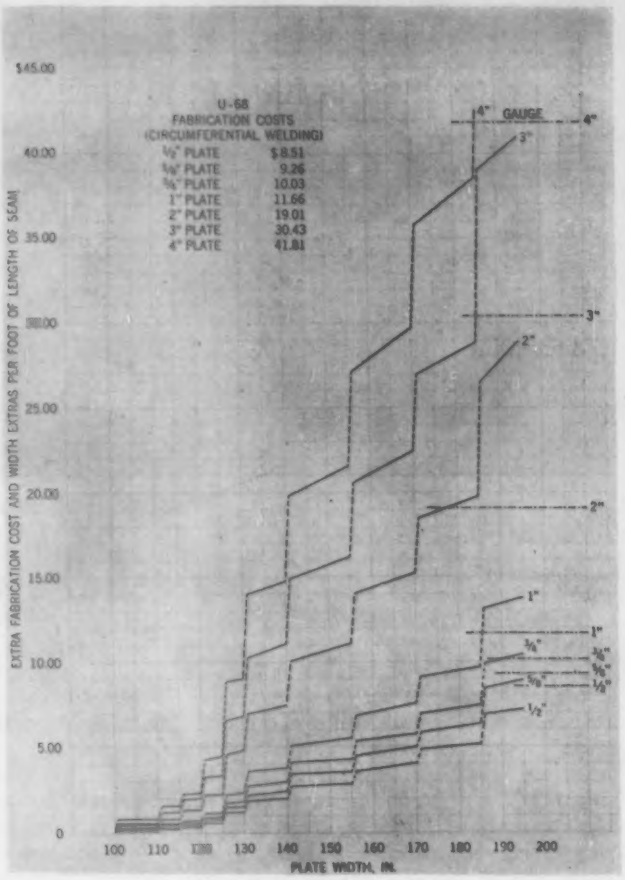


Fig. 8—Another nomograph based upon Table II. It differs from Fig. 7 in that the extra fabrication costs and width extras are given per linear ft instead of per 100 lb.

A ½ in. shell 132 in. wide will have a fabrication cost of $3.60 per 100 lb ($8.51 per ft) if constructed from two plates 66 in. wide by circumferential welding. This is shown in Fig. 7 by the intersection of 132 in. with the ½ in. curve. One plate 132 in. wide would involve a width extra cost of 75c per 100 lb and result in a saving of $57 per ton in this shell.

The point at which a curve crosses the width extra line in Fig. 7 indicates the plate width for which the width extra equals fabrication cost. On any curve, at any width to the left of the point of intersection with the width extra line it is more economical to pay the width extra and use one-piece construction. At any width to the right of the point of intersection, it is cheaper to weld two plates to form the shell or cylinder, assuming that manpower is available for the extra shop work and that production volume is not a major factor.

Fig. 7 shows that where ⅝ in. or lighter plates are used, it is always more economical to pay the width extra and use one-piece construction. With ¾, 1, 3 and 4 in. plates, one-piece construction is more economical in plate widths up to 185 in. With 1½ and 2 in. plates, it is more economical up to approximately 180 in. The locations of these points will vary with the fabrication costs when grades of construction other than U-68 are used.

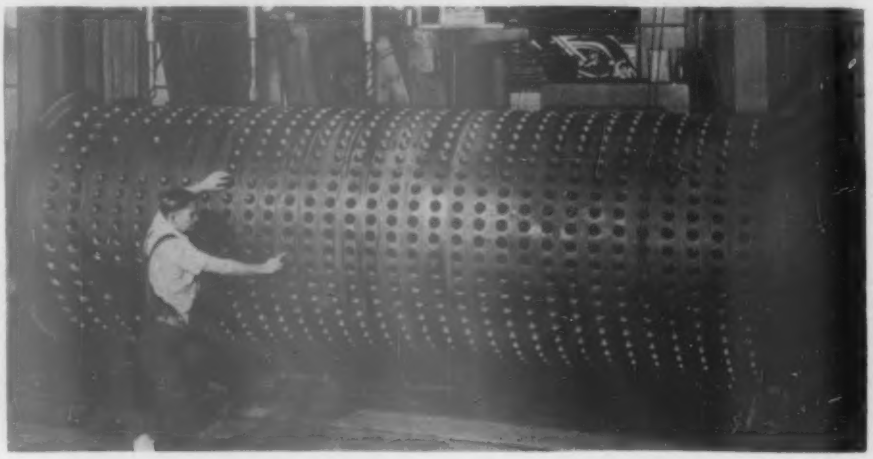
Longitudinal Welding

Though Fig. 7 is based on circumferential welding, it can be adapted also to longitudinal welding. As a consequence of the more favorable position in which the welding is performed, the fabrication cost for longitudinal welding is slightly lower, and hence the curves would be somewhat lower for longitudinal welding. The costs for U-68 longitudinal welding as compared with circumferential welding are given in Table II.

To simplify still further the comparison of width extras and fabrication cost, the width extras have been converted to cost per ft of length of

(Please turn to page 64)

Fig. 9—One of 40 pressure vessels fabricated from single plates. Note that there is no circumferential weld to interfere with the location of the tube holes.



★ CONSTRUCTION

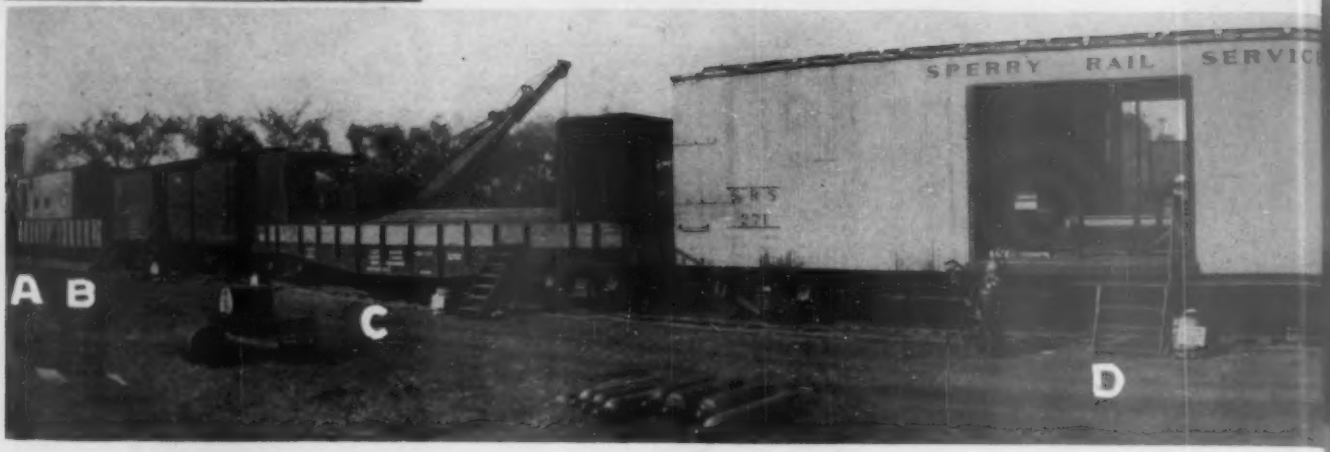


Fig. 1—A train for flash welding. Left to right: locomotive (A), generator car (B), rail rack car (C), welder car (D), weld inspection station (E), stress-relieving oven (F), grinder stations (G, H and I).

Welded Railroad Rails

Gapped joints between railroad rails will have to go when increased train speeds demand continuously even rail surfaces to provide shock-proof transportation of both freight and passengers. The first article of this series (November, 1944) explained why the expansion caused by temperature increases is not a problem of the all-welded continuous rail and described the fundamentals of the oxy-acetylene pressure method of welding rails.

The second installment (December, 1944) was devoted to thermit welding, with emphasis upon the important Moffat tunnel job. The present article, the last in the series, will cover the application of the flash-welding process to railroad rails.

THE advantages of all-welded railroad rails are many: the elimination of expensive joint maintenance, reduced track maintenance, increased rail life, no end batter between rails, no rail creeping, better line and surface, increased tie life, smoother riding trains, less maintenance of locomotives and rolling stock. In view of these convincing reasons, it is little wonder that so many railroads have been installing long stretches of welded rails during the past 14 years. It is a trend that is sure to continue and one that promises an important market for welding in tomorrow's postwar world.

Fig. 2—Rack car. Loaded by crane, it automatically feeds rails to the welder.

Welding Difficulties

Unfortunately, railroad rails are not easy to weld. Owing to the nature of the service to which they must be subjected, welds of the highest quality are absolutely essential, for the welded joint must be comparable to rail steel in the physical specifications of tensile strength, hardness, impact value and fatigue resistance. Yet fast production is equally essential, for trains must move and railroads cannot be tied up indefinitely while the changeover is being made from bolted to welded rail.

Even one 39 ft rail is cumbersome and hard to handle; this difficulty is multiplied many times with a long string of rails welded together. The ends to be welded are of large area and irregular cross-section, having adjacent thick and thin sections to be brought to welding heat at the same time—no easy matter. Finally, rail steel is high-carbon steel (0.70% C), and welds in this material are almost certain to crack unless a carefully controlled procedure of preheating and stress relief is followed.

Three Welding Methods

In the face of the above difficulties, the welding industry has evolved not one but three successful methods of rail welding. The oxy-acetylene pressure process and thermit welding have been discussed in previous articles; the third method, flash welding, will be now considered.

By CLYDE B. CLASON

★Part Three—The continuous rail offers a big market for welding in the postwar world. The third and final installment of this series discusses the flash-welded rail and the equipment that is needed to produce it.

A Two-Speed Process

Flash welding is a direct descendant of the original low-pressure resistance-welding machine patented by Elihu Thomson in 1877. It is a form of butt welding, and hence is often referred to as flash butt welding. In butt welding proper, however, the workpieces are clamped together under rather high pressure before power is applied; flash welding differs in that it is a two-speed process. Light pressures are used in the initial stages to permit the "flashing" of the work surfaces, and high pressures in the upset operation, which forges the pieces together. The burning or flashing serves a two-fold purpose: it smooths the surface for welding (thus eliminating the necessity for grinding unless the surfaces are rusty or covered with a rust preventative) and generates heat which renders the material plastic for the final forging operation.

Flash welding was first applied to railroad rails in Europe. European rail steel is generally 0.40% carbon, which is easier to weld than ours, and many authorities felt that the process could not be successfully applied on this side of the Atlantic. About ten years ago, however, engineers of Sperry Products, Inc., in coöperation with the General Electric Co., developed a successful rail flash welder.

First Installation

The pioneer installation of flash-welded rails was made by the Delaware & Hudson Railroad in 1937. Strings of welded rails varying in length from 780 to 1,500 ft were produced by automatic flash welding and joined by closure welds upon installation in the track to give continuous-rail sections up to nearly 1½ miles (7,018 ft).

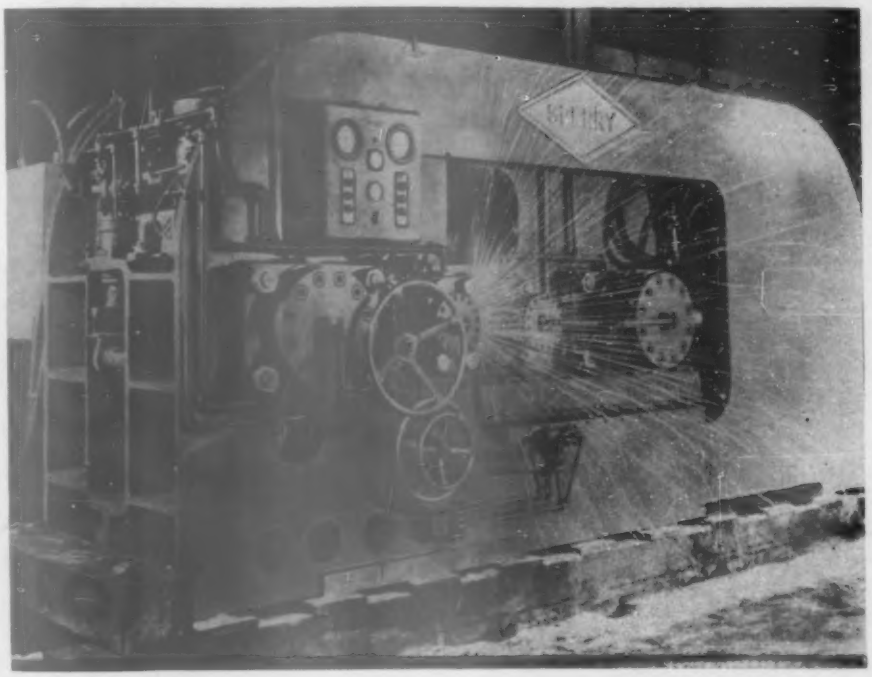
Two years later the Erie Railroad used 1,500 ft flash-welded rails to replace the westbound track of its Otisville, N. Y., tunnel. Flash-welded rail was also laid through the Pennsylvania station in Philadelphia in order to minimize the destructive effects of vibration caused by the many trains passing over the main line tracks supported by the building's structure.

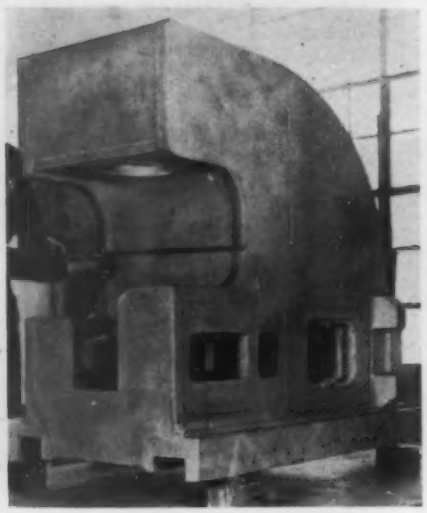
More recently, the Paulista Railway built a plant at Rio Claro, State of São Paulo, Brazil, for reconditioning used rails and for welding both new and reconditioned rails into 225 ft strings. Flash-welding equipment was purchased for the latter purpose.

Flash-Welding Advantages

Though the actual number of machines installed has not been large, a total of 37,217 rail welds have been produced to date by this process—a number more than sufficient to demonstrate the three principal advantages of the flash-welding process: speed, quality and control. With regard to the first of these, the welder's

Fig. 3—This rail flash butt welder starts with a low rate of flashing and accelerates its speed. An end of the short piece of rail being welded can be seen at the left side. Lengths of railroad rail up to 7,018 ft have been welded on this machine.





Courtesy, Lukens Steel Co.

Fig. 4—The platen holds and conveys the rail during the welding operation. It measures (round numbers) 5 ft long by 3 ft wide by 5 ft high, weighs nearly 5 tons. Both the welder frame and the platen are fabricated by flame-cutting and welding.

production rate, if satisfactory facilities for rail handling are available, is approximately 17 welds per hr—one weld every 3½ minutes. As many as 20 welds per hr have been obtained.

Quality and control are tied closely together. The soundest type of weld results because automatic control is able to eliminate the vagaries of the human element and assure exactly the right values for: (*a*) temperature of metal at the rail ends (*b*) rail travel during flashing, (*c*) initial and push-up pressures, (*d*) split-second timing of each operation.

Consistency of quality is another advantage. Once the proper values for a particular rail have been determined by experimental or empirical means, the same settings and procedure will continue to produce welds of identical quality. The failure percentage for 37,217 welds is 0.07%, according to latest figures.

The rapid flashing just before the push-up excludes all of the atmosphere between the workpieces, and thus no oxide inclusions (slag) can form in the final stages. Any oxidized metal formed previously will be squeezed out under the final push-up pressure.

Four Failures, 7,200 Welds

Over 7,200 flash welds were put into service in the main line track of the Delaware & Hudson Railroad. All of these are subject to temperature variations of well over 100 F. To date, there have been but four weld failures. Two of these were due to zinc in the weld, caused by using galvanized iron shims to line up the rails in the welder. One was due to a pipe in the end of the rail being welded, the surface of which separated under pressure and produced a transverse crack in the web of the rail. The fourth failure was caused by short circuiting when current was applied through the contacts at the base of the rail, resulting in burned spots on the base.

A rolling-load machine developed at the University of Illinois was used for fatigue tests of full-section steel rails. The rail was mounted in the machine as a cantilever (supported at only one end) with the weld line 1½ in. from the support; it was then passed back and forth under a 65,000 lb wheel load, 60 cycles per minute, until failure occurred. This test was designed to subject the rail and weld not only to bending moment but also to all of the various complex stresses incident to heavy wheel loads.

Test Results

It was found that failure began at less than 1,000,000 cycles for welds which had not been given postweld heat treatment. Welds given heat treatment followed by a cooling in still air fractured at 2,000,000 to 5,000,000 cycles. Best results were obtained from welds given a postweld treatment of (1) cooling 3 min, (2) heating to 1,250 F in 3 min and (3) slow cooling for 20 min; these welds showed no sign of failure at 6,000,000 cycles* when the test was discontinued. The welds so treated revealed no signs of incipient cracks after their grueling ordeal. A section was cut from one of them and etched; it disclosed a sound, homogeneous weld.

Other causes of comparatively early failure were allowing the upset metal to remain under the rail head (failure at 1,336,700 cycles) and welding at the too-high speed of 50 seconds (failure at 738,800 cycles).

Six-foot samples of 131 lb rail were also drop tested. The rails were set on supports 4 ft apart, and a one-ton tup was dropped from a height of 22 ft so that its anvil would strike the weld, located midway between the supports. Of 17 drop tests made on flash-welded joints, only three failures occurred on the first blow. Three and four blows were generally needed to break the rail, and even then the fracture might occur entirely outside the welded region.

* 3,000,000 cycles with the rail mounted as a cantilever and an additional 3,000,000 cycles with the rail mounted as a simple beam.

A Train for Welding

There is a disadvantage to flash welding: the expensive and cumbersome equipment it entails. A typical rail flash-welding unit (Fig. 1) is a train having a locomotive, a generator car, a rail rack car (Fig. 2), a welder car and several flatcars for inspection, stress relieving and grinding. Needless to say, only a large and wealthy railroad can afford to invest in all of this equipment and then only when a job of considerable magnitude is involved. A flash-welding service is offered, however, for jobs in which the purchase of equipment would not be economically justified.

The equipment centers around the electric welder (Fig. 3), which is contained in a housing 15 ft 5 in. long by 5 ft ½ in. wide by 7 ft high. A platen (carriage) rests on guide rails within this housing. The platen (Fig. 4) measures 5 ft 3 in. long, 3 ft 2¼ in. wide, 5 ft ⅞ in. high and weighs approximately 9,600 lb. Both platen and housing are of all-welded construction, fabricated of parts flame-cut and formed from rolled steel plates. The guide rails, which permit a reciprocating motion of the platen, are made of a steel selected because of its machinability, weldability and wear resistance.

The instrument panel and operator's controls are located on the front of the welding machine. Two concentric handwheels control the vertical and horizontal alignment of the ends of the two rails to be welded. Another handwheel, providing manual control

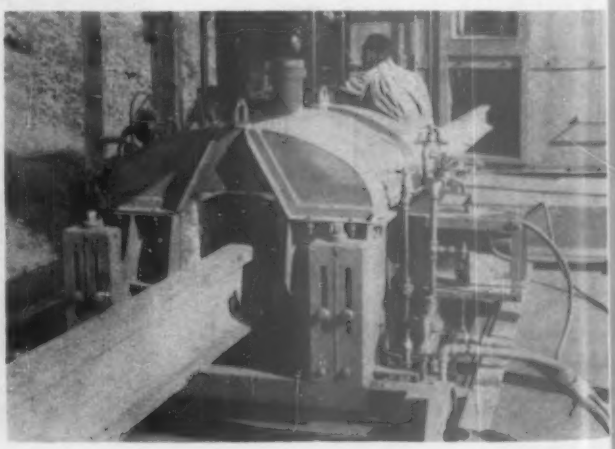


Fig. 5—After cooling and inspection, the welded rail is required to pass through this oil-fired stress-relieving furnace.

of the platen movement, is used to shear the upset metal from the bottom of the rail base afer welding.

Recording meters make permanent records of voltage, amperage, wattage, platen movement and stress-relieving temperature for every weld.

Welding Procedure

Because of the effects of flashing, it is not necessary to prepare the rail ends (unless they are rusty) by grinding them prior to welding. Burrs or other irregularities of as much as ¼ in. magnitude will be eliminated by the flashing before the rails are pressed together. It is necessary, however, to provide clean surfaces for the electrical contactors; this is done by grinding the running surface of each rail with a portable angle grinder, air-driven or electric-powered, for a distance of about one foot from each rail end.

The rail previously welded is held in a fixed position in the machine while the new rail is fed in. The rails are gripped by hydraulically operated dies shaped to conform to the rail contour, and an electrical contactor bears on each rail. The welding cycle is automatic and is initiated by a pushbutton switch. The cycle is in three stages: preheating, rapid flashing, upset operation or forging.

A constant voltage is applied across the ends of the two rails to be welded, and they are brought together at a constant speed. When the rails touch, flashing begins, throwing out particles of molten metal and heating the metal remaining. If the voltage drops a small percentage, the automatic control bringing the rails together will stop the movement for an instant, permitting the voltage to rise. If the voltage drops a greater amount, the movement will be reversed for an instant, permitting the voltage to rise rapidly. Thus the flashing is maintained and the faces to be welded are prevented from sticking before they have been properly prepared.

High-Rate Flashing

When enough metal has been flashed off at the low rate to insure a uniform gap between the faces (as well as to heat the adjacent metal to red heat), the high-rate flashing begins. The rails are brought together at increased speed, and the flashing becomes both continuous and intense. The rapid flashing is allowed to continue until a layer of molten metal has been produced on each of the faces to be welded.

The final operation is to push the now plastic rail ends together under great pressure (around 10,000 psi). The forging pressure will squeeze out some of the molten metal, which immediately forms a ridge about the welded joint. The upset metal under the rail base is removed before it can harden by means of the shear attached to the welder platen. The loss of metal through extrusion and through flashing will shorten a 39 ft rail by about 1 inch.

Inspection, Stress Relieving

The welded rail is moved out of the machine by means of a winch remotely controlled by the welding operator. It is allowed to air cool for 3½ minutes while an inspector checks the alignment of the top and sides of the head and the sides of the rail base. He also makes a careful visual inspection of the weld.

After the first cooling, the welded rail moves up to another car for stress relieving in an oil-fired furnace (Fig. 5). Here the temperature is brought up to 1,250 F in 3 minutes. Accurate temperature control is provided by a recording pyrometer (Fig. 6), which also furnishes a graphic record of the stress-relieving heat treatment given to each weld.

Passing from the furnace, the weld is covered with an asbestos hood in order to retard its second cooling until the temperature drops to approximately 600 F. At the end of 20 minutes, the hood is removed and the weld allowed to air cool to the temperature of the ambient atmosphere.

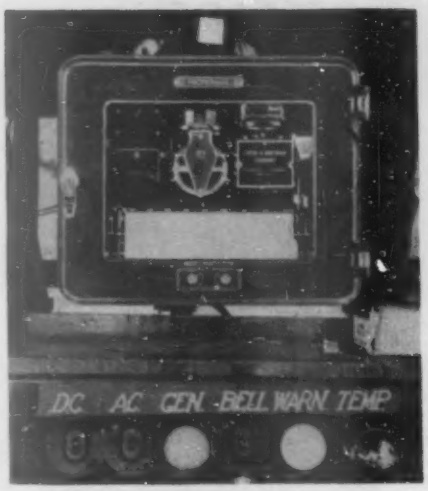


Fig. 6—A recording pyrometer provides accurate temperature control for stress-relieving and furnishes a graphic record of the particular heat treatment given to each weld.

Grinding

Except for the flash under the rail base, all of the extruded metal at each joint is removed by grinding. Three operations are necessary. The running surface is precision ground to the standard rail contour by means of a high-speed electric grinding machine (Fig. 7). A similar grinding machine is used to trim the sides of the rail head. A portable air-powered or electric fillet grinder is then employed to partially remove the upset metal from under the head and from the top and sides of the base. Finishing touches are delivered by hand filing.

The transportation of strings of welded rail as long as 1,000 or even 1,500 ft offers no insuperable difficulties and has been covered earlier in this series (THE WELDING ENGINEER, November, 1944, page 43). Once laid in the track, the sections are joined to their fellows by closure welds made by the thermit process.

It is interesting to note that sections of continuous rail as long as 1½ miles will expand no more than an ordinary 39 ft rail, and that all of the change in length will take place at the ends of the welded section.

Of the four branches of welding, only the versatile arc-welding process is not used extensively for railroad rails. Under conditions of proper control, an oxy-acetylene process, a thermit process, and a resistance-welding process will all give satisfactory results. The question of which method the railroad engineer should choose must, therefore, largely depend upon the economic factors of the particular job.

THE END

Fig. 7—A high-speed electric grinding machine gives the top of the rail the standard contour.

Welding with A

By ROY NORTON

Manager Weldrod Div., Ampco Metals, Inc.

Welding a bronze flange to a steel pipe. The welding of dissimilar metals is made practicable by the development of the aluminum-bronze electrode.

BRONZE, like gold, has been very influential in controlling and guiding the life of man from the dawn of history. The early history of bronze dates back as far as 6,000 B. C., and the Egyptians in 3,500 B.C are known to have been producing bronze implements important to their civilization. Even the word "bronze" itself is very interesting. It can be found in medieval Latin as the word "bronzio" meaning brown and, prior to this, can be further traced to the name of the ancient city of Brondisium on the Adriatic Sea.

Bronze and Brass

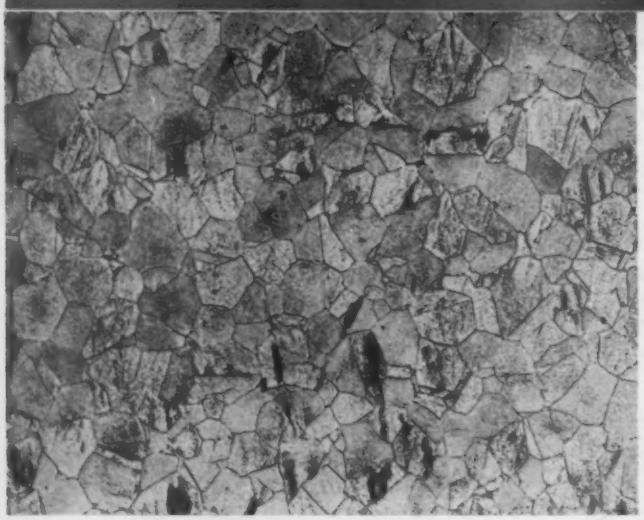
At some time or other you have probably said bronze and meant brass, or vice versa, and then stopped to wonder just exactly where these two gold-colored materials actually differ from each other. For purposes of definition, bronze is an alloy of copper and tin (or other elements exclusive of zinc). The original bronze was probably an accident—the result of a tin percentage in the copper ore being smelted.

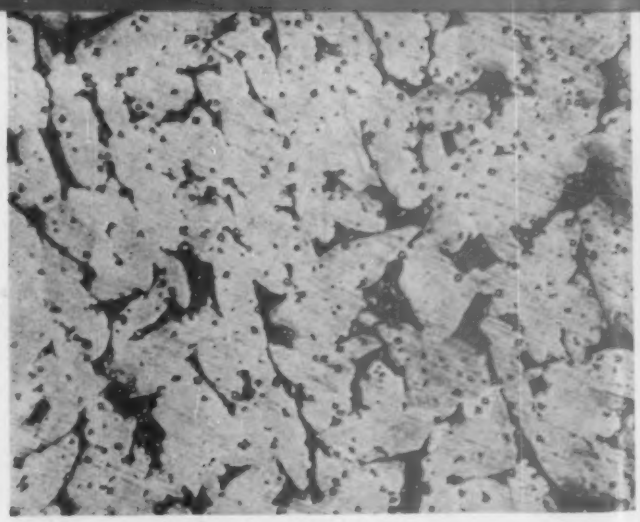
Brass, which is identified as an alloy of copper and zinc, did not become known until much later, approximately 600 B. C., because zinc, unlike tin, is not a native metal or ore found in a comparatively pure state. The zinc compounds of an ore called Chalco were used in the initial production of brasses.

An important milestone in both the military history of the world and the history of bronze was the production of 42 bronze cannon cast to guard the straits of the Dardanelles. These cannon were immense, even in today's conception of big guns. Each of them weighed 18 tons, had a 25 in. bore, and fired stone shot weighing 600 lb. These monstrous guns were made in two parts and had to be screwed together and apart after each loading and firing. Crude as these cannon were, their effect against the British in 1807 was devastating.

Changed National Boundary

The history of bronze is also linked





Aluminum Bronze*

The aluminum-bronze electrode, though a mere baby of only two years, has an enormous capacity for tackling tough jobs. It is used in both maintenance work and original fabrication, for both welding and hard-facing.

Directly with our own history as a nation. Our own Benjamin Franklin arbitrarily changed the boundary line defining Canada and the United States because of his interest in copper ore at the time the boundary was being negotiated. He was interested in finding a supply of domestic copper for furthering electrical experimentation. During the course of boundary negotiations with Canada, he was informed by Jesuit priests of a queer, greenish-colored ore on Isle Royale of Lake Superior. Upon sending a sample of this ore to Philadelphia, he found it to be copper ore, and so he changed the boundary line to include in the United States that territory which now comprises portions of Minnesota, Wisconsin and Michigan.

The then wholly unknown Mesabi iron range of Minnesota was unwittingly included in the boundaries of the United States by this lucky stroke of Benjamin Franklin's pen.

Bronze is today a vital alloy. The ancient material in its present highly developed form is filling countless needs. It is daily going into battle in the parts of tanks, guns, airplanes, ships and many other implements of war.

A Newcomer among Alloys

Since this article is immediately concerned with aluminum bronze and welding, it might be advisable to say something about the family of alloys known under the generic term of "aluminum bronze." Bronze alloy development has followed roughly parallel lines to the rapid metallurgical developments in the steel industry over the period of the last two or three decades. Aluminum bronzes, for instance, were not produced industrially much before 1910 and were not widely used until about 1930. Since that time they have been given increasingly wide acceptance and use in all phases of modern industry because of certain exceptional characteristics.

These outstanding characteristics of the aluminum-bronze family are:

1. High tensile strength, ranging from 65,000 to 110,000 psi.
2. High impact strength, enabling the alloy to resist shock loading.
3. Good corrosion resistance.
4. Excellent bearing properties.
5. High strength at elevated temperatures.
6. Response to heat treatment.
7. Controlled hardness—100 to 350 Brinell.

Basic Alloys

Although there are as many as 25 different aluminum bronzes, they may all be considered as variations of a few basic alloys. The aluminum bronzes may be defined as copper-base alloys containing from 5% to 14% aluminum, with the possible addition of a maximum of 5% of a third element such as iron and also a possible addition of manganese or nickel or a combination of the three. Since the greater tonnage of aluminum bronzes contain iron as the third alloy, we will accordingly confine this article to the iron-bearing aluminum bronzes.

Aluminum bronze, in many compositions and chiefly in the higher aluminum contents, definitely responds to heat treatment. In welding, the filler material and adjacent parent metal are of necessity subject to phases of heat treatment. It is important, therefore, that we inspect aluminum bronze for its possible reaction to heating.

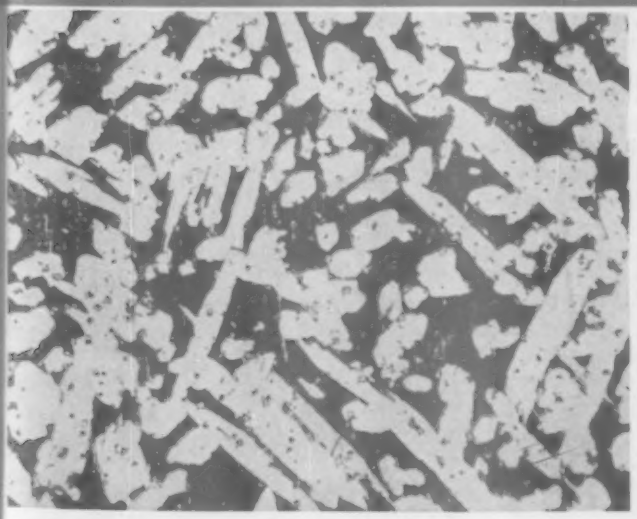
Like oil and water, some metals will mix but not dissolve in one another. Lead and copper are a good example of this class. Other metals will dissolve into each other as sugar will into water. Aluminum and copper are a good example. In dissolving into each other, moreover, the two metals form a new substance or alloy with properties entirely different from either of the two original metals.

Alpha, Beta, Delta Phases

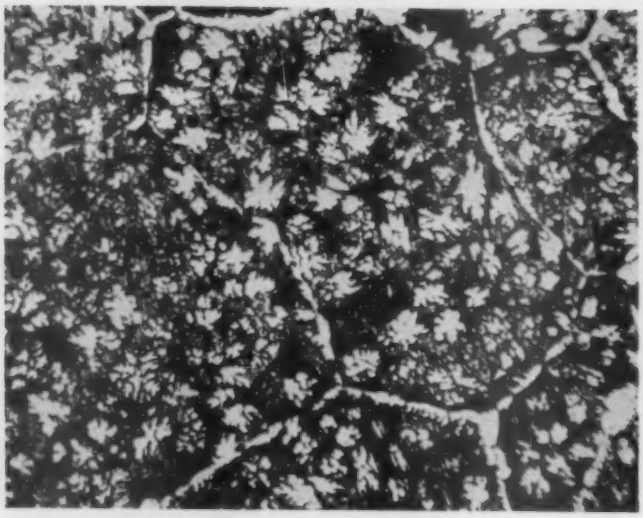
In dissolving aluminum and copper, if the aluminum content is 9.5% or less, an aluminum-bronze is formed which is technically known as an "alpha" type alloy. If the aluminum percentage is increased to 11.8%, a second or "beta" phase is formed, which is somewhat analogous to a supersaturated solution of sugar and water. The "beta" phase is actually another alloy or composition within the original or "alpha" phase matrix

*An original article based upon material presented in an informal talk before the Chicago Section, AWS.

Aluminum bronze of 50% alpha, 50% beta phases. Again the black portions are beta.



Heat-treated aluminum bronze of 50% alpha, 50% beta. Note the finer structure, indicating higher physicals.



Aluminum bronze of 50% beta (black) and 50% delta phases

Aluminum bronze of 75% Eutectoid and 25% alpha phases. The Eutectoid is the fine filigree

—technically another alloy or composition within an alloy series.

Upon increasing the aluminum above 11.8%, still another aluminum bronze is developed. It is known as a "delta" type alloy and contains a third or delta phase. This is again another combination of copper and aluminum and it is a third separate alloy within an alloy series.

Eutectoid Phase

Although not as directly connected with composition as the alpha, beta and delta phases, there is another alloy formed in aluminum bronze that must be considered. This phase is known as Eutectoid† and it is actually an inversion or transformation of the beta phase that takes place at temperature between 600 and 1,050 F.

Because of its brittleness and consequent problems in connection with machining, the Eutectoid phase is to be avoided whenever possible. To avoid development of this undesired phase or alloy, aluminum bronze should never be furnace cooled or otherwise slow cooled in the approximate range from 1,050 to 600 F.

Usually two or three of the above phases are present in a given aluminum-bronze alloy, and that alloy will have physical properties proportionate to the amount of each phase present. In other words, an almost limitless number of alloys is possible in the aluminum-bronze series, dependent entirely upon their exact compositions of copper, aluminum and iron and the rate at which they are cooled. For industrial purposes, however, the basic possible combinations have been reduced to about six classes of alloys.

†The Eutectoid is that particular composition of an alloy of two or more metals which has a minimum melting point—Editor.

Physical Properties

The actual physical properties of these various phases have not been specifically determined, but for our discussion the approximate values of tensile strength, ductility and Brinell hardness given in Table I will help in understanding aluminum bronzes.

To further clarify our picture of composition, let us think of the alpha, beta and delta phases in more familiar terms such as copper, iron, and tool steel. Another good analogy is to imagine a piece of cloth woven from material of alpha, beta and delta alloys or, as we have considered them, copper, iron and steel. You can see that the resultant cloth will have physical properties directly proportional to the amount of each alloy that has been used to fabricate the material.

This is, of course, a crude representation of alloying, but it enables you to picture clearly the separate alloys within aluminum bronze and the possibilities of obtaining the exact material you require by controlling the percentage of each alloy present. To go one step further, the percentage of each alloy present can also be controlled by definite heat-treating methods.

Effects of Temperature

With this picture as a background, you can readily see that it is quite easy to have a wide range of physical properties in aluminum bronze. It will now be necessary to consider the effects of temperature and cooling rate upon these three phases. Though it is not our intention to try to give the complete heat treament for all the possible variations in composition, we can well pause to consider the effect that can be produced in aluminum bronze by subjecting it to a heat treatment.

To explain correctly the operation of the three variables controlling the heat treatment would require a diagram that is quite complicated and hard for anyone other than a metallurgist to interpret. Let's look at it in a simpler way. If we will consider the possible material we can obtain by varying the proportions of our alpha, beta and delta phases, we can see that wide variations of physical properties may be obtained. Now add to this the thought that by proper heat treatment, we can further control and exactly set our percentages of alpha, beta and delta according to temperature and rate of cooling, and you can readily understand that we do have a metal that can be made to fulfill the most varying requirements.

As an example, it is necessary that we have as much alpha phase as possible in order to obtain the softest range. This may be accomplished by using the proper alloy, subsequently heating it to 1,050 F and then air cooling. To obtain the harder range, it is necessary that we have as much beta and delta present as is possible. This may be accomplished by using

Table I. Physical Properties of Aluminum-Bronze Phases

Phase	Tensile Strength	Ductility	Brinell Hardness
Alpha	65,000	30%	120
Beta	85,000	5%	270
Delta	55,000	0	465
Eutectoid	85,000	2%	285

proper alloy, subsequently heating to 1,650 F and then water quenching. Bear in mind, please, that these are only general statements on average conditions and would necessarily have to be modified to give a specific heat treatment for a given composition.

Welding Electrodes

Prior to the appearance of aluminum-bronze electrodes, no high-strength welding rods of bronze alloy were available. In this respect, bronze electrode development lagged far behind the general bronze industry, which has for some time been producing alloys of tensile strengths up to 100,000 psi.

One reason for the seeming backwardness is that several of the high-strength bronze alloys contain zinc, a metal unsuitable for welding electrodes because of its vaporization at welding temperature and consequent injury to the original physical and chemical properties. To weld such alloys and achieve comparable strength, zinc-free electrodes such as are available in the aluminum-bronze alloys are required.

In addition to the lack of zinc in their composition, aluminum-bronze electrodes offer the other advantages of high strength, hot ductility and controlled hardness. All of these features have made the development of aluminum-bronze electrodes of prime interest to the users of the high-strength bronze alloys—particularly to users of the high-strength alloys containing zinc, such as manganese bronze.

Aluminum bronze was for many years considered to be an alloy unsuited to welding because of its refractory, oxide-forming characteristics. Specifically, aluminum oxide is very highly refractory and is, moreover, very hard to flux. Aluminum-bronze welding was not practicable unless there could be produced a flux-coated welding rod capable of sufficiently preventing the formation of aluminum oxide to permit a sound weld.

This electrode was developed about two years ago in response to the demand by users of aluminum bronze in cast or wrought form. It has now, however, progressed beyond that stage and is widely accepted for fabricating dissimilar metals such as brass, bronze, copper, steel, malleable and cast iron. It is used also with nickel alloys for depositing bearings and wearing surfaces and for corrosion-resistant fabrication.

Gas Welding, Carbon Arc

Aluminum-bronze coated electrodes are now adaptable to oxy-acetylene, carbon-arc and metal-arc welding. It is well to point out, however, that oxy-acetylene welding with these electrodes is sometimes quite difficult because the aluminum oxide is so refractory and hard to flux. The same coated electrode is used for oxy-acetylene welding as for carbon-arc or metal-arc welding. Nor is any extra flux required.

For carbon-arc welding, direct current is used with straight polarity. The size and type of carbon electrodes are important. In general, the electrode should be of material made specifically for carbon-arc welding and large enough to carry the current efficiently without excessive burn-off. Generally, a carbon rod is preferred.

The carbon rod should be formed with a 4 or 5 in. taper and have approximately a $\frac{1}{16}$ in. diameter tip. The welding technique is the same as the usual carbon-arc procedures, although it should be borne in mind that deep penetration of the base material is not desirable. The arc should, therefore, be carried on the molten bronze and not allowed to play on the base metal or on any spot on the weld metal long enough to penetrate to any appreciable depth. A rapid weaving motion should be used—as rapid as is possible without sacrificing proper fusion at the edges of the bead.

Metal-Arc Welding

Aluminum-bronze electrodes for metal-arc welding are used with direct current, reverse polarity (electrode positive, work negative). A-c electrodes are not now available although the present large expansion of a-c welding makes it highly probable that an a-c electrode will soon be introduced. Approximately the same arc lengths and the same current ranges are used with mild-steel electrodes, although the arc operation itself is quite different. In aluminum-bronze welding, the globules of metal form at the electrode tip and are intermittently transferred across the arc at close intervals. With mild-steel or low-alloy electrodes, a steady stream of tiny globules is ordinarily experienced in the arc.

Practice by the operator and familiarity with the aluminum-bronze electrode from use is needed to assure good welds in the flat position. With sufficient practice, vertical and overhead welding can also be accomplished under certain conditions.

As in all bronze welding, cleanliness is a prime necessity for good welds, and moisture should be avoided as it tends to cause porosity in the deposited metal.

In overlay work, *i. e.*, the overlaying of steel or cast iron, it is particularly desirable to avoid deep penetration. A rapid weaving motion is used, and care should be taken to apply the arc at all times to the molten deposited bronze, never on the base metal. This procedure distributes the heat and keeps to a minimum the dilution that would otherwise be experienced if the arc were allowed to penetrate or contact the parent metal.

On most overlay applications, a minimum of dilution from the parent metal is advisable. This necessitates the use of a low welding current with a wide and rapid weaving motion. In addition, the base metal should be preheated to 300 to 500 F wherever possible as this will enable the weldor to use a correspondingly lower welding current.

Spatter loss of aluminum-bronze electrodes is high in comparison with mild-steel electrodes, but it can be reduced to a minimum by using a relatively low welding current and depositing the beads with a weaving motion.

Numerous Applications

The applications for aluminum-bronze electrodes are quite wide in their scope as they include both the actual fabrication of weldments and the deposition of overlay for the purposes of wear resistance, hardness, corrosion resistance and repair. A wide variety of bearings, slides, gears, cams and bearing surfaces can be profitably fabricated or overlaid with aluminum bronze.

Forming or drawing dies offer another good example of the advantageous use of aluminum-bronze welding. It is possible to apply to such dies a smooth, non-galling surface on which alloys (including stainless and low alloy steel) can readily be drawn without the danger of surface defects.

Welding a cast-brass pump housing for the chemical industry.

Bucking the Buckling

It can be done successfully only by keeping in mind the fundamentals: (1) expansion and contraction will occur wherever heat is applied to metal; (2) there is also the likelihood of distortion or warpage if the heated metal is restrained from its normal movement.

By **ARTHUR H. BROWN**
Manufacturing Research Engineer, Vultee Field Div., Consolidated Vultee Aircraft Corp.

Fig. 1—The author is holding a welded aluminum duct against a surface plate. Note the squareness and flatness of the bottom piece.

IT HAS been found that warpage and subsequent buckling may be controlled, or at least minimized, by the application of certain fundamental theory to the jigging and welding procedure. Since aircraft manufacturers have few castings to weld in which triaxial expansion occurs, this discussion will be limited to biaxial expansion of sheet products. Buckle is caused not by expansion but by uneven expansion. It can be avoided by uniform heating of the entire assembly, but it is impracticable as a method of avoiding buckle to keep large assemblies preheated overall to above 950 F during the entire welding cycle. It is logical, therefore, that we seek some method of relieving the stresses set up by local heating and expansion and thus accomplish almost the same result as uniform preheating.

Circles: Yielding, Unyielding

A simple experiment will give us the clue to one method by which stresses can be relieved. Lay a circle of sheet aluminum on a fire brick and heat the center with a torch. The heated area in the center will expand, but the circle as a whole will not. The expansion forces out a flow of metal along the plane of the material, but this flow is resisted by the unyielding cold peripheral container. Hence the metal is forced to take up the expansive difference in area by arching above or beneath the plane.

Now take another circle of sheet aluminum and make a cut from the edge to the center. Repeat the experiment previously described. You will notice that most of the expansion has been relieved by the cut, which opens and allows the periphery to expand. Thus the centrifugal flow of expanding material is accommodated, and there is no buckling.

This physical fact may be used to advantage in butt welding. In making a butt weld, the plates are placed so that the seam is open at one end and closed at the other. The vee gap should be set open a distance of ap-

Fig. 2—A welding jig utilizing a counterbalanced ball-bearing trunnion was developed for the part shown in Fig. 1. Note the Standard Practice chart at lower left.

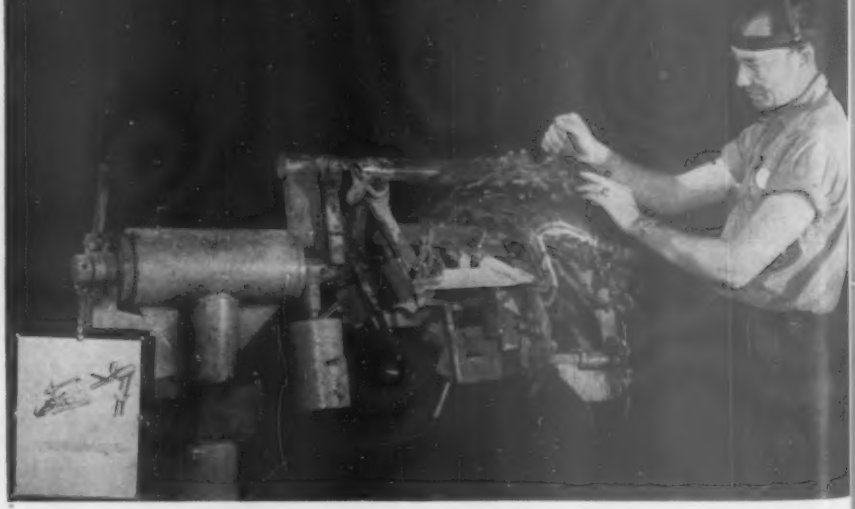


Fig. 3 — Sandwich-style welding jig mounted on table-type positioner. The base of the jig is a block of steel, which is heated before the operations are begun in order to control expansion of the aluminum assembly to be welded. Heat is restored to the block by the welding.

proximately ⅛ in. per foot. Then as welding progresses, the weld bead (the expanded area) travels down the seam. As the metal cools behind the weld, the weld itself is in tension. Thus the metal flow is inward, and the vee gap is progressively closed. If the gap has been preset correctly, the seam will close completely but without any overlap.

Jig Requirements

To make this type of weld, the jig must be specially designed so as to allow the part to slip in a plane through its edges but not to joggle out of that plane. Backing plates, in the ordinary sense of the word, cannot be used because the backing plate will absorb the heat from the welded segments.

We found that we obtained the best results by facing a solid backing plate with screen. Since the screen has reduced surface area, it does not contact a sufficiently large area of aluminum to pull a noticeable amount of heat out of the weld.

Fig. 1 shows a duct which bolts to the header plate of an intercooler. It is essential that the open square end be flat and perfectly square. If the duct is flat but out of square as welded, it will always go out of flat if squared and vice versa. In other words, it must be welded so that it is both flat and square at the same time, or it cannot be made to fit the drill jig. Ordinary welding methods proved insufficient; it was necessary to make cuts in the corner and weld in fish-mouth patches, file the whole and finally to hand work until the desired condition was attained. A rework time of as much as 1¾ hr per duct was not uncommon, using these methods.

To Do It Mechanically

It was important for us to develop a jig that would make it possible to weld the units free from residual buckle and so eliminate all the expensive hand work. This jig (Fig. 2) was built on a counter-balanced ball-bearing trunnion. The square base would be held flat and square, exactly as we wished it to be when cooled, while the two top parts were contracted into place by the heat of welding. Screen-faced backing plates line the seams, and "fingers" hold down the edges in plane but not too tight together. The postweld contraction of the metal is then able to pull the top parts into place as the units normalize.

Standard Practice Charts, giving a detailed, step-by-step procedure, are hung from the jig at all times for the weldors' reference.

Fig. 1 shows the author holding one of the welded ducts (which is perfectly square) on a surface plate. The unit is as taken from the jig. The results obtained with the jig are decidedly worthwhile. Sixty-eight units a day have been turned out for about a year with nothing more to do than check-and-straighten operations following welding. No units have been lost, even though several new weldors have used the jig for full shifts.

Sandwich-style Jig

Another of the principles previously discussed for eliminating buckle was used in the jig shown in Fig. 3. The flat plate of this assembly would buckle so badly when welded by ordinary means that considerable reworking was necessary in order to get the bottom back in proper contour.

We built a jig which would be used with a table-type positioner. Chief element is a large block of steel, which is insulated from the turntable by an asbestos pad. This block is brought up to a temperature of about 1,000 F before welding operations are started.

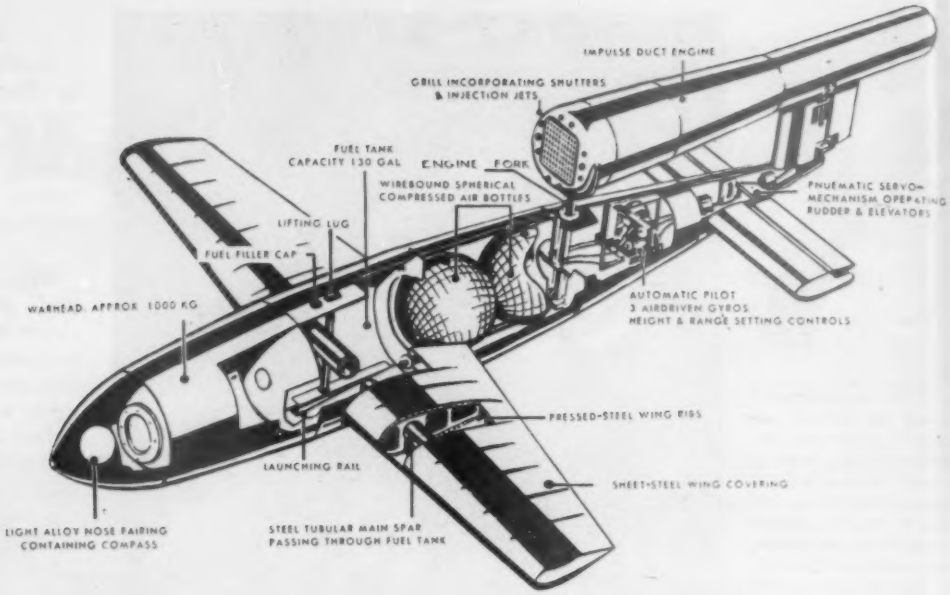
The preheated steel block is contoured to the shape of the assembly's bottom plate. A tooling pin located the plate in one corner and a block holds one side. The whole plate takes an almost immediate preheat from the block and is free to expand sideways. The heat is restored to the steel block during the weld. The plate is held sandwich-style between the preheated block and a cover plate. However, the rapid-acting clamp of the cover plate does not hold the plate tight.

The tube of the assembly is located at the top by a round gate on the end of an internal brace and by a screen core at the bottom. The gate pivots to let the welded part out (Fig. 4), and thus no part of the jig need be detachable.

The foot-controlled table rotary has proved itself to be an excellent expedient in this type of welding.

Proper jigging will greatly increase the scope of welding applications. Such ingenious jigs as these, which permit the weldor to take advantage of the natural forces involved in the particular welding operations, will easily make possible the accomplishment of the "impossible."

Fig. 4—Removing the assembly. An asbestos pad insulates the preheated jig from the turntable.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LAUNCHING RAIL
SHEET-STEEL WING COVERING
LIGHT ALLOY NOSE FAIRING CONTAINING COMPASS
STEEL TUBULAR MAIN SPAR PASSING THROUGH FUEL TANK

Fig. 1—Cutaway view showing component parts of the Nazi V-1 flying bomb.

Robot Bombs Made by Welding

Ninety days after fragments of the V-1 flying bomb had been salvaged in England, U. S. engineers had produced a complete working model. Here are the technical facts uncovered regarding Hitler's no-longer-secret weapon.

By **T. B. JEFFERSON**

THE Nazi flying bomb is the most terrifying and devastating missile of destruction yet to be turned loose in this global conflict. Loaded with 1,800 to 2,200 lb of explosives, these small, all-metal, all-welded monoplanes began flying over Southern England on June 12—just six days after the Normandy invasion began. During the following three months some 8,000 V-1 bombs were believed to have been launched. Approximately 2,300 of them (about 29%) succeeded in getting into the London region.

The damage has been appalling. These new attacks by air had, up to the first of September, killed 5,478 people, injured 15,394 others and damaged or destroyed 1,104,000 homes. After September 1, however, the intensity of the bomb attacks was reduced, and eventually the launching bases in the Calais and Dieppe regions fell into Allied hands. Nevertheless, flying bombs still fall in England. Some of them are launched from more distant land bases. Others are launched from planes, being transported to within striking distance "piggy-back" fashion on Nazi bombers.

Foretaste of the Future

The V-1 flying bomb is in reality a jet-propelled airplane. Because of its many unusual features, its construction is of particular interest to the welding industry. It contains several welding innovations which may later be incorporated in our future aircraft—planes which will be manufactured through extensive use of resistance and arc welding.

The V-1 is 25 ft 4½ in. long and has a wing span of 17 ft 8 in. It is capable of carrying an 1,800 to 2,200 lb warhead at speeds of between 250 and 360 miles an hour. Robot bombs have been known to fly as far as 170 miles; their normal cruising distance, however, is believed to be around 125 miles. The total weight of the loaded bomb is probably around 6,000 lb.

With so many interesting features to describe, it is difficult to know just where to begin. By referring to Fig. 1, the reader may obtain the general details of flying-bomb construction. All of the major component parts of this instrument of destruction are shown in the cutaway illustration. Profile and plan views of the bomb, together with a few dimensional details, are given in Fig. 2.

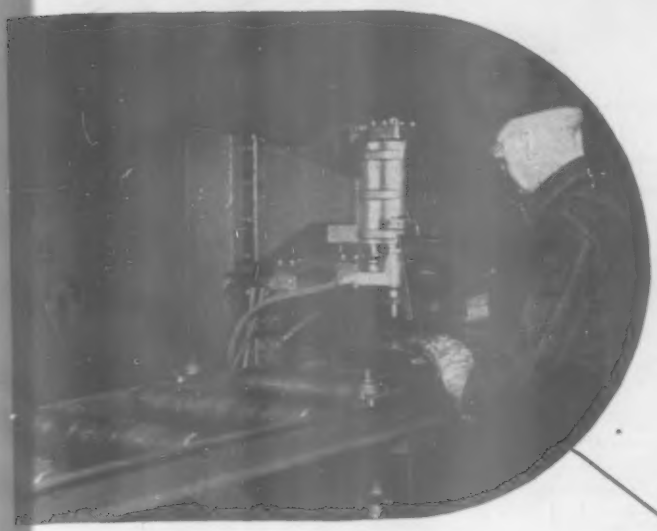
Steering Mechanism

The nose of the bomb is an aluminum-alloy shell housing the magnetic compass. The compass is mounted in a wooden case and is connected with the gyro (automatic pilot) units which steer the bomb on its proper course. The compass is necessary in order to give the bomb its directional flight characteristics, inasmuch as some bombs were launched in a direction away from England. After flying in that direction for a preset number of minutes, they later changed their courses to fly towards the target. Evidence that this was done is afforded by the clocklike mechanism which has been found in wrecked bombs.

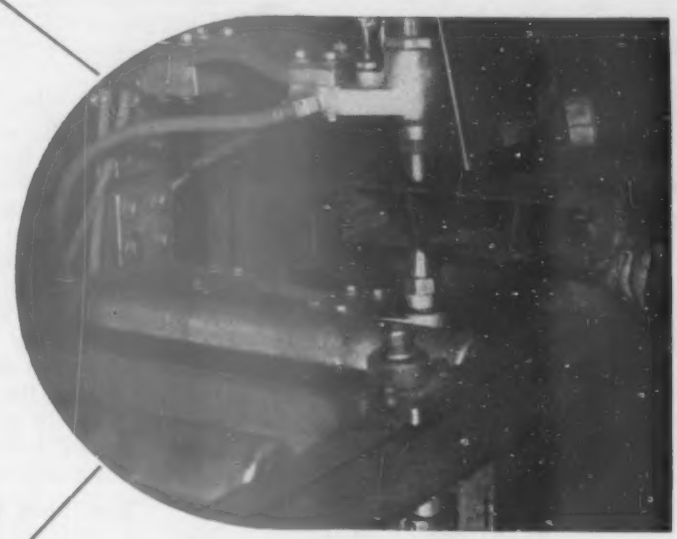
The warhead is immediately behind the compass compartment and attached to it by four bolts. The compartment for the explosive charge is fabricated by welding mild-steel sheet of approximately 14 gauge. The warhead is 4 ft long and measures 24 in. in diameter at the forward end and 32 in. in diameter at the rear. It thus has the shape of a frustrated cone.

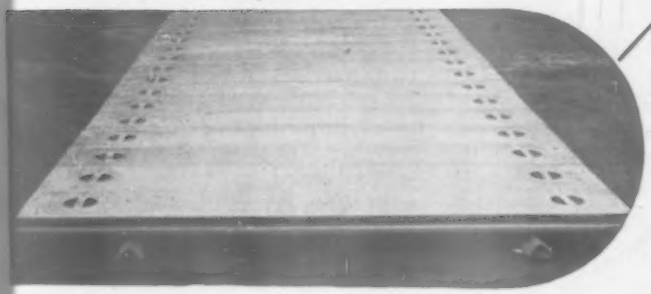
Fuel and Air Tanks

Immediately behind the warhead is the fuel tank, also held in place by four bolts. The fuel tank forms an integral structure with the wings and will be described in greater detail later on. Continuing towards the rear of the bomb fuselage, we find next a compartment for two spherical air tanks. The shell of this compartment



Conveyorized Spot Welding with a PWC Pedestal Welder





Top: Steel hatch cover sections for ships having Z-bar reinforcements welded into them while passing down a conveyer. The Machine is a modified Standard PWC 100 KVA Welder.

Center: Top and bottom Z-bar flanges are welded simultaneously, the current going through the Z-bar. The welder is equipped with upper and lower guns. Machine compensates for current losses.

Bottom: It takes sixteen sections to make a unit and three units to make a hatch cover. The design and process saves many pounds and makes it simple for only 2 men to open and close a hatch.

Not so long ago, many people would have said that a job like this was "impossible": series welding a Z-bar of #11 gage steel into a box of #14 gage. Twelve spot welds are made on each Z-bar. Production averaged approximately 75 to 80 sections per hour (30 secs. per section at peak production). Material was fairly scaly hot-rolled steel.

To do this job, a PWC Pedestal welder equipped with lower as well as upper gun was built right into the conveyer line. The machine like other PWC equipment is designed for ready conversion for post-war production requirements.

For the complete story on this operation ask for Welding Pictorial #37.

For further information on the PWC line of standard Pedestal welders ask for Bulletin #502.

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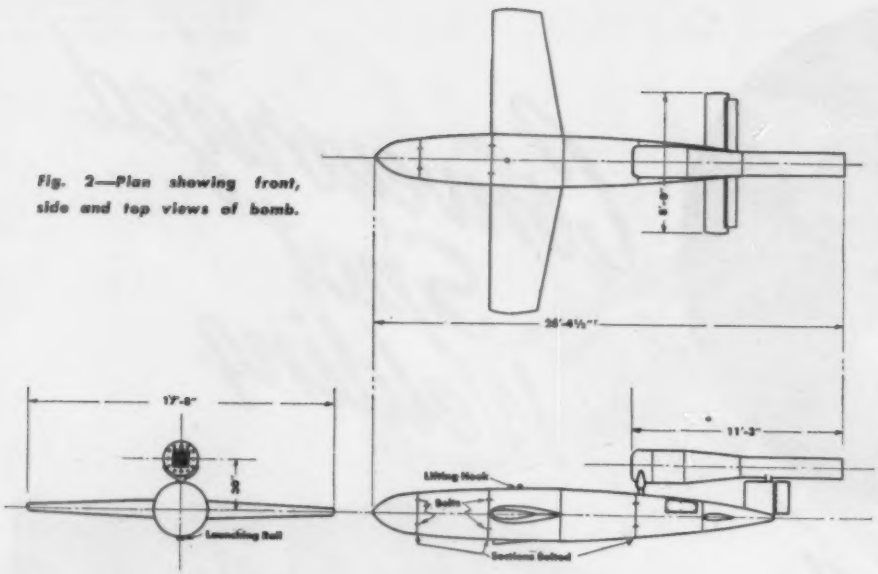

Fig. 2—Plan showing front, side and top views of bomb.

is welded to the fuel tank. Both shells—the air-tank compartment and the fuel tank—are of ⅛ in. thick mild steel.

Another welded unit is the tail section of the plane, containing the gyro controls and the air-servos which operate the rudders and elevators. This section is fastened to the forward sections by the inevitable four bolts. It should be noted that the fuselage is of stressed-skin and bulkhead contruction; there are no longerons. The impulse duct engine is mounted above the tail section by means of a forward fork (quite similar to the tail-wheel fork of conventional airplanes) and a single post faired in by the vertical fin.

Wing Structure

The most interesting features of the flying bomb will be found in its combined fuel-tank-and-wing structure. The main spar of the wing is a seamless tube, 4½ in. in diameter and of ⅛ in. wall thickness, which extends the full length of the wing. About 18 in. from each end, the tubing is reinforced by a ⅛ in. steel wrapped sheet (Fig. 3). This sheet fails to come together by about ⅛ in. and is intermittently welded by a bead, which also ties it to the tubing. These welds are ¾ in. long and spaced on 2 in. centers.

The spar is further reinforced by ⅛ by ¾ in. bands tack welded to the spar at intervals. Where the spar passes through the fuel tank, it is enclosed in a ferrule of seamless tube of ⅜ in. wall thickness. This ferrule is welded to the tank shell so as to prevent any fuel leakage around the spar.

The wings themselves appear to be made from 18 or 20 gauge mild-steel sheets. Since the wing section is symmetric, either wing may be used as a right or a left-hand wing. The only way to determine which is which is to inspect the camouflage, which on the bomb examined was olive drab on top and light blue underneath. The landing edge is in a straight line, with all of the taper in the wing being taken in the trailing edge. The wing chord tapers from 28 in. at the tip to 44 in. where the wing joins the fuselage. The ribs were pressed from 22 gauge sheet metal and made in two pieces: top and bottom panels.

Ribs Spot Welded

The wing skin was fastened to the ribs by spot welding. Apparently, the ribs were spot welded in place on a large sheet before it was placed on the wing; then the sheet was merely folded together so that the halves of the ribs overlapped slightly. The rib joints (overlap) were then spot welded again. The wing was probably assembled in this manner, using gun welders to do the rib-welding job. The trailing edge was then welded to complete the all-welded steel wing. The wing tips were closed by welding steel stampings to the skin and to three projections on the end of the spar.

The fuel tank, which may be considered part of the wing structure, is 32 in. in diameter and 44 in. long having a capacity of about 162.5 U. S. gallons. It has dished heads and was made entirely of ⅛ in. thick mild steel. The spar ferrule passes through the tank in a horizontal plane, and in addition a lifting tube passes through it vertically. The latter tube is attached to the bottom of the tank and bolted through the tank to the launching rail. The lifting tube is approximately 6 in. to the rear of the spar ferrule.

The upper end of the lifting tube is threaded to fit a detachable lifting eye. A flush-type, airtight fuel filler cap is located just forward of the eye. Because of the severe launching surge, the tank is fitted with a baffle of ⅛ in. mild steel. The baffle is located approximately in the center of the tank and fitted with heavy screens to cover the openings at its top and bottom.

Air-Pressure Operation

When the bomb is in flight, the tank is under an air pressure of 100 psi in order to assure the feeding of fuel to the impulse engine. The air inlet is through a small tube in the top of the rear head and connected to the air tanks. Fuel is discharged from the bottom of the same head to the impulse engine.

Compressed air is carried in the two spherical air tanks, which measure 20 in. in diameter. These tanks are press-formed in halves and welded together. Because of the high pressures carried, the tanks are wrapped with three layers of wire ribbon. The ribbons are wrapped in a criss-cross fashion around the tank, just as one would wind a ball of string. Each ribbon is composed of 16 strands of 1/16 in. piano wire, which have been laid side by side, clamped and sol-

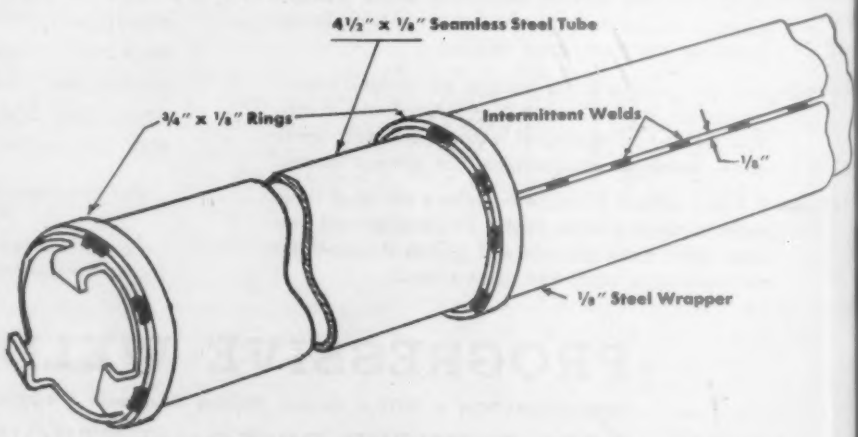

Fig. 3—Detail of spar construction showing welds and methods of reinforcement.

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Unique construction and operating features of Wells' Rod saver Electrode Holder enables users to cut rod costs. Here's how!

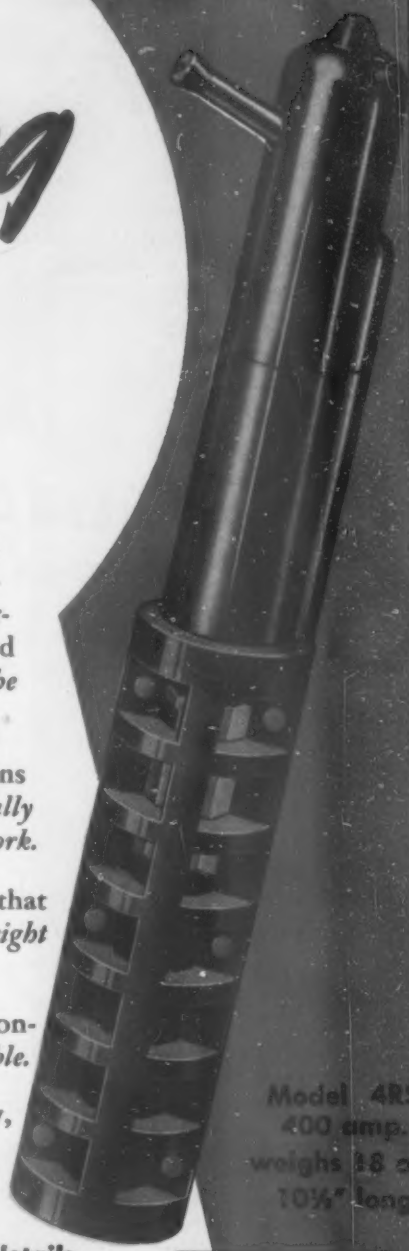
1. High pressure grip of the stud on the rod is positive and provides a solid connection on 3 sides of the rod. This reduces overheating at the contact point between the rod and the holder and *permits consumption of the rod right down to the last inch.*

2. High pressure grip—up to 1,000 lbs., means ease in bending rods to desired angle. *Practically all of rod is used because you can get closer to work.*

3. High pressure grip—up to 1,000 lbs., means that no rods are dropped. *Every rod can be burned right down to 1".*

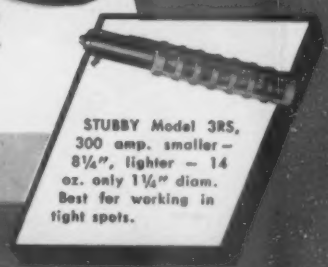
4. High pressure grip assures better electrical contact with rod—*more efficient burning of rods is possible.*

5. Due to design of insulator cap and vise body, only 5/8" of rod—the uncoated tip—is gripped by holder. *Coated surface of rod is undamaged.*



Model 4RS
400 amp.
weighs 18 o
10½" long

Our distributors will give you more details about how Wells' holders cut rod costs, reduce maintenance, increase production.



STUBBY Model 3RS, 300 amp. smaller—8¼", lighter—14 oz. only 1¼" diam. Best for working in tight spots.

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dered together. Markings indicate that the tanks were originally tested to 225 atmospheres—a pressure of 3,375 psi. British authorities tested them hydrostatically to 3,000 psi without any sign of rupture.

Fin and Stabilizer

The vertical fin is constructed of 20 gauge mild-steel sheet. Like the wing, it is spot welded throughout. Spot welding is used also to fasten the fin to the fuselage. The stabilizer, which passes through the tail section, is likewise spot welded to pressed-steel ribs. Undoubtedly, poke welding was used since this unit is a closed assembly. The control surfaces, elevators and rudder, are also of spot-welded construction. All control is maintained through these two members, inasmuch as the pilotless plane (the V-1) does not have ailerons.

Like a large portion of the fuselage, the engine duct is also built of ⅛ in. sheet and fabricated by arc welding. The forward portion of the duct is 20 in. in diameter; the tail pipe narrows down to a diameter of approximately 12 in. The duct has an overall length of 11 ft, 3 in. and is located 30 in. above the center line of the fuselage.

Jet-Impulse Engine

Capable of developing an estimated 600 hp, the impulse engine is of an ingenious type. Its power comes from a series of rapid explosions (approximately 2,500 per minute) occuring in a combustion chamber. The front end of the duct is equipped with a unique "gate" which opens to admit air for combustion and closes after each explosion in order to prevent the loss of the energy developed. The gate is a shutter arrangement necessitating some 225 springs of the steel-reed type.

Initially, a spark plug is used to ignite the fuel, after which the heat of the engine provides self-ignition. The jet engine uses about 1 gallon of gas for each minute of flight and is capable of driving the bomb at speeds ranging between 250 and 360 mph.

Welding is indispensable to the construction of the Nazi flying bomb, which, military leaders have declared, might have won the war had it been developed earlier. But all of the secrets of its manufacture are ours now, and we can do a far better job of production output than the enemy. The robot bomb may turn out to be a boomerang.

★

Carbon-Arc Welding

By **GERALD ELDRIDGE STEDMAN**

AMONG the important new welding developments at North American Aviation, Inc., is the use of the carbon arc for welding aluminum alloys. Copper-coated carbon electrodes which develop a "straddle flame" that just touches the work are used (Fig. 1). The tongue of the "flame" travels about ¼ in. above the abutting flange in the weld area and is applied at a slight angle.

For Flanged Joints Only

The carbon arc has been found from North American research to be a very satisfactory and economical method for welding 2S, 3S and 52S aluminum alloys. However, it is only suitable for the standing seams of flanged joints. On this type of joint, the North American tests indicated that the carbon-arc method was from two or three times faster than conventional gas welding. An a-c arc, supplied from a standard welding transformer with a nominal rating of 100 amp and continuously adjustable current between 25 and 125 amp, is necessary—at least for the gauges between 0.032 and 0.080 in. A "tapped secondary" on the transformer for current adjustment is not as satisfactory.

There needs to be much study of proper design in electrode holders. Fig. 2 shows one North American design of a production electrode holder. Alcoa No. 22 and No. 24 weld flux are used, but the former tends to pop off with heat while the latter is not affected.

Jig design holds the flanges together and no tack welding is needed.

Fig. 1—Using copper-coated carbon electrodes, an operator arc welds a flange joint on an aluminum alloy part. The "straddle flame" is applied at an angle and barely touches the work.

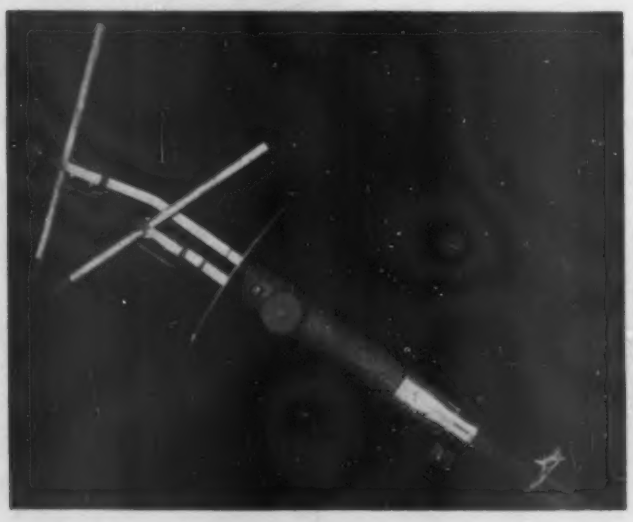

Fig. 2—A production model of the carbon-arc electrode holder developed at North American Aviation's Inglewood, Calif., plant.

Comparative Speeds

A speed of from 12 to 18 in. per minute was developed in N. A. A. research as compared to a speed of 6 to 10 in. per minute with gas torches—both on 0.032 and 0.081 in., 52 SO aluminum alloy.

Experiments are proceeding on the welding of castings to sheet stock by this method, and the preliminary results are encouraging.

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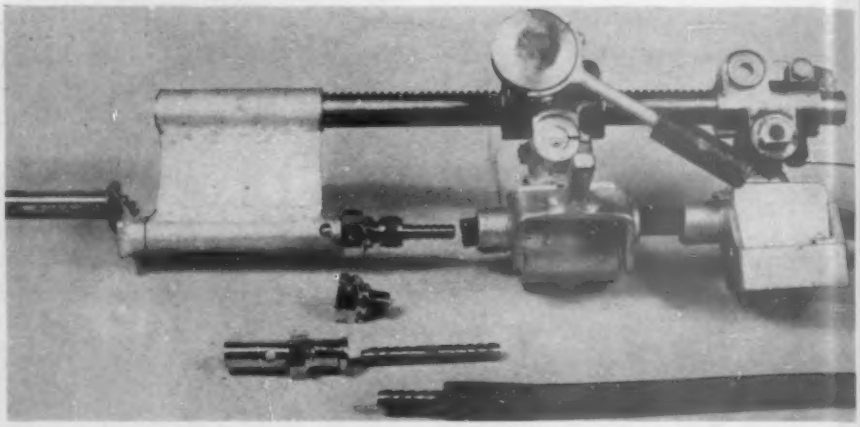
A few of the many time and labor-saving ideas developed by tacticians of the production line are presented every month in this department. If you have a good welding idea of your own to pass along, you are hereby invited to contribute it to the cause of victory. Send anything you think suitable for Short Cuts and Kinks, THE WELDING ENGINEER, 506 S. Wabash Ave., Chicago 5.



Fittings are easily affixed to oxygen and acetylene hoses with this simple jig.

Pipe Clamp

By George W. DeHaven

BUTT welding operations on various-size pipes have been greatly expedited and facilitated by the use of a newly created adjustable clamp I devised for use at the Philadelphia navy yard. It was submitted under the Navy Employees' Suggestion Program and accepted as a suggestion.

The clamp, somewhat similar in general appearance to other pipe clamps, was designed to permit easy access to the welding area. In addition, it is provided with liners, held in place by machine screws, which will adjust the jaws to pipes 1 in. to 4 in. in diameter. If a large pipe is to be welded, the removal of one or two of the liners is all that is needed to accommodate the greater size. Correspondingly, the replacement of a liner will prepare the clamp for a smaller pipe. The clamp is hinged on one side and is provided with a locking jaw and clamping bar.

The former method of performing this operation was to attach at the butt end of each pipe a circular clamp fitted with lugs to receive four bolts with nuts. By attaching the bolts to clamps and pulling them up tight, the butts could then be held firmly together and in place. This method, however, was never satisfactory as the bolts became fouled with slag during the weld. The new way of holding the pipe in hinged clamps does away with former difficulties, has increased production and improved the quality of the work. The estimated saving realized through use of this suggestion is approximately $150 per year.

Hinged clamp for pipe welding. Removable liners permit quick adjustment to pipes 1 to 4 in. in diameter.

» «

Hose-Fitting Jig

By Aubrey J. Swinson

AT THE Norfolk navy yard we used to attach oxygen and acetylene hose fittings by hand. Since this was a laborious task, it was small wonder that the maintenance of hose proceeded at a slow pace. Furthermore, the repairs were made by various individuals, including the operators of the torches themselves.

I submitted an idea to the Navy Employees' Suggestion Program which called for the introduction of a hose-fitting jig and centralized hose repair. This, I said, would greatly increase production possibilities. Since the suggestion was adopted, operations in hose repair and the attachment of fittings have been stepped up considerably.

The jig is simple in construction and may be mounted on any anchoring device available. The "base" is primarily a collet or holder for the fitting. Attached to the base by welding is a spindle provided with a rack, and an attachment for carrying the hose is mounted on the spindle. The carrier is provided with a split sleeve; this may be opened wide to admit the hose and then clamped tightly when the hose is in place.

With the fitting set in the base and the hose held securely in the sleeve, the carrier is drawn toward the base by operation of a lever. The lever rotates a gear meshed with the rack on the spindle, thus imparting motion to the carrier. In this manner the hose is easily forced onto the fitting, whereupon the assembly is released from the carrier. Thus the job is very quickly done.

The hose-handling capacity of the jig is much greater than assembly facilities under the former hand method, and the fitting operations can be performed with comparatively unskilled labor whereas formerly the job had to be done by skilled workmen. The centralization of hose repair frees operators for production work. Altogether, annual savings of $600 are realized through the adoption of this suggestion.

» «

Gas Box Shut-Off

By J. S. Rutley

WHEN a fire would break out in one of the gas boxes at Moore Dry Dock Co., the main acetylene gas line had to be shut off and then it would take several minutes for the remaining gas to burn out. This would stop all flame-cutting on both hull and skid. Even after the fire was out, the workers had to wait until the box and the water seal had cooled as these had to be tested for leakage before the main gas line could be turned on again.

To overcome this deficiency, I suggested that an extension be attached to the handle of the acetylene gas box shut-off valve, which is located inside and at the bottom of the box. The extension handle would permit operation from outside of the box. This suggestion was adapted by the War Production Drive Committee. When a fire now occurs, the worker crawls under the skid to the particular box on fire and turns off the gas with the acetylene shut-off valve.

The cost of putting in this extension was approximately $4 per box, and it has been installed in all of the boxes. This safety device eliminates work stoppage from fires since only the flame-cutting operator whose box is on fire has to stop work. Formerly all flame-cutting was stopped, and this meant a loss of at least half an hour for all operators.

The saving in man-hours will depend, of course, upon the number of flame-cutting operators who are employed in the affected area.

A TYPICAL STORY OF G-R'S ON THE JOB...

"Higher Production - Better Welds - Lower Costs"

● Early in 1940, Weld-Rite Welding Works put their first G-R Model 45 to work on Diesel engine bases (shown above). This pioneer western welding concern quickly noticed that production time went down; with magnetic blow eliminated and the hazard of undercutting reduced, inside fillets and "tight corner" welds went on smooth and fast. And G-R's smooth, stable, all-position arc resulted in better quality, better looking welds that kept customers happy and spoilage low.

In the following four years, Weld-Rite bought four more G-R's—convincing proof that G-R's deliver the kind of results *you* want in a welder!

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Backing-Strip Shear

By Primo Maffei

THE difficult, time-consuming task of removing backing strips from weldors' test plates is one encountered with every test plate. To simplify the chore somewhat, I devised a special shear capable of doing this job. My idea was submitted to the U. S. Navy Beneficial Suggestion Program at Hunters Point, Calif., naval drydocks and was accepted.

Pneumatic shear for the removal of backing strip from weldors' test plates. An idea that saves time.

Basically, this is an application of a pneumatic shear to the removal of backing strips from weldors' test plates. The shear is operated by a foot pedal and will remove the backing strip in less than a minute. How it works is shown in the accompanying illustration, where a test plate is ready for the slicing off of the backing strip.

The shear makes possible clean, fast removal of backing strips, and welding flaws are not smeared over as was the case when a chipping gun was used. Estimated savings of the equipment amount to 25 man-hours per day.

» «

Submerged-Melt Flux Bowl

By H. O. Allen and C. R. Anderson

IN submerged-melt welding, it is usually quite a job to change the contact jaws after they have been somewhat worn. A suggestion to the Labor-Management Committee at Richmond Shipyard, Richmond, Calif., won a prize for us by overcoming many of the old difficulties.

In the accompanying illustration (right) is the old-style flux bowl as used on submerged-melt welding equipment. Our new-style flux bowl (left) places the melt spreader below the contact jaws so that it is no longer necessary to remove the melt spreader to remove the jaws. As a result, the jaws of the machine can be kept cleaner and can be removed in 5 to 10 minutes instead of taking the 45 minutes previously necessary. This suggestion saves many man-hours and greatly speeds production.

» «

Welder Analyzer

By H. R. Patterson

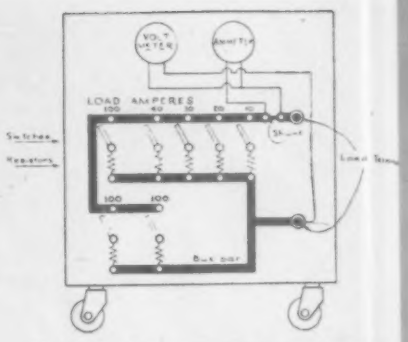
ARC-WELDING equipment was formerly tested in the shop with variable loads produced by changing the depth of a plate in a barrel of salt water. This liquid rheostat would become very hot from continuous use. Resistance units if available were also employed as another method of testing welding machines by wiring them in various combinations to obtain the desired load. Both of these methods were crude, clumsy, slow, irregular, inaccurate, expensive and dangerous.

I suggested to the Labor-Management Committee of Kaiser Co., Inc., Portland, Ore., that a portable welder analyzer be made and used for this job. The idea was adopted, and the analyzer is now being used regularly.

The portable unit is used to read voltage and current for loads of from 10 to 400 amp. Switches permit any division in units of 10 amp. The resistances are enclosed for safety in heavy wire mesh and held in a sturdy frame supported by castors. Handles are provided to move the machine or to lift it on and off the truck. An accurate voltmeter and an ammeter which indicates polarity are mounted on top of the panel board. Metallic labels are stamped in large letters to aid in the operation of the panel board.

Advantages presented by this unit are:

1. Neat, simple design.
2. Maneuverability. The entire unit weighs only 125 lb and is easily taken to the welder on the job. This eliminates shutdown of equipment, hauling welders to shop, etc.
3. Large terminals and knife switches (with other features) result in a rapid analysis of welder troubles. Lost time of weldors and other workers due to shutdowns is thus greatly reduced.
4. The resistance units provide an even, steady load which gives accuracy in analysis.



Sketch showing panel arrangement and wiring of welder analyzer developed by H. R. Patterson, Kaiser Co., Inc., Portland, Ore.

5. Heat is dissipated easily and safely.
6. The analyzer is always available for rapid action.
7. The cost of the equipment is soon repaid by the savings obtained.
8. Analysis of the welder on the job settles arguments and misunderstandings regarding performance, dial settings, etc.

» «

Welding-Wire Winder

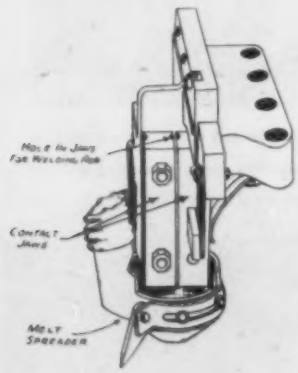
By L. Taricco

THE reeling of automatc welding wire was a three-man job when a hand-operated reel was used. Two men were required to turn the reel while one man fed the rod. As a part of the Labor-Management Suggestion Drive at Consolidated Steel Corp., Wilmington, Calif., I devised a motor-driven reel winder that can be operated by one man.

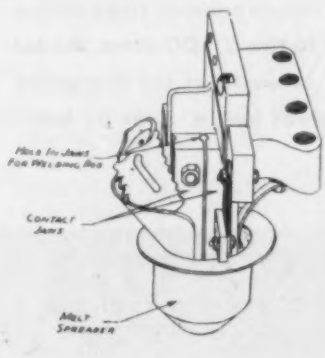
This idea was adopted and a subsequent reel winder was built. The frame was of scrap angle iron with a gear box set inside. An air motor was fitted to the gear box, and a shaft from the latter drives the winding reel.

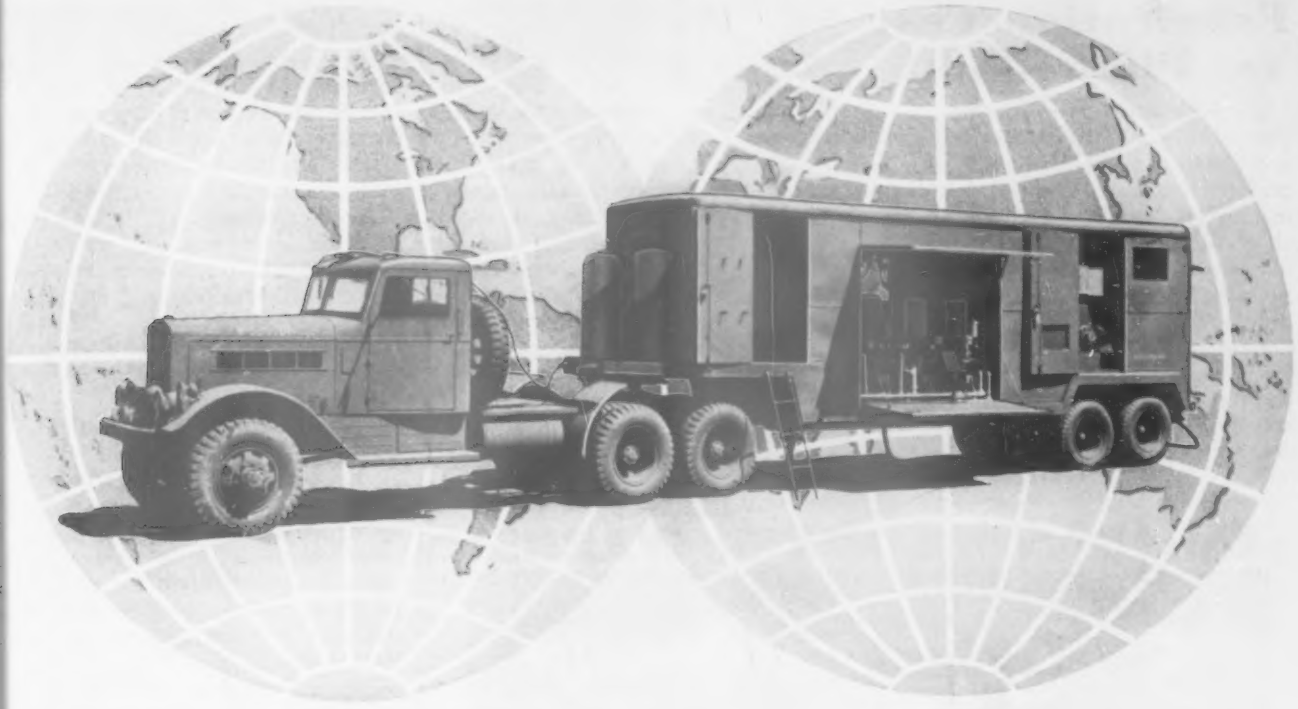
Since this machine can be operated by one man, it has resulted in the saving of 21 man-hours per hull in the winding of automatic welding rod. Another advantage is the complete elimination of rewinding. One hull requires 164 reels of rod, and by the old hand method it was necessary to rewind one out of every 11 reels—a total of 15 reels per hull.

Mechanical winder for automatic welding wire. A gear box and an air-driven motor eliminated the work of two men.



Right: old-style flux bowl and left: new-style flux bowl designed for submerged-melt welding. With the new model, contact jaws remain clean and so have to be changed only half as often.





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Fabrication Cost vs. Plate Width

(Continued from page 43)

plate in Fig. 8. The fabricating costs are shown on the graph by broken horizontal lines at levels corresponding to the values tabulated on the chart for various gauges of plate. These costs are based on the data previously given. If a fabricating cost differs from the value tabulated, a horizontal line should be drawn at a level representing that cost and the point of intersection with the corresponding width extra curve should be determined. This point gives the optimum width of plate for that fabricating cost.

For a 1 in. plate having a fabricating cost of $11.66 per ft, Fig. 8 indicates that the width of plate should be as great as the design permits up to 185½ in. For a 2 in. plate, the fabricating cost of $19.01 per ft crosses the width extra curve at a width of 177 in., indicating that the use of any two-plate construction to make up a dimension of less than 177 in. would be more expensive than single-plate construction.

Costly Mistakes

A single plate 2 in. thick and 140 in. wide would cost $7.50 per ft for width extra. If the fabricator elected to weld two plates 70 in. wide to form the 140 in. wide shell, it would cost him $19.01 per ft of length, a loss of $11.51 per ft of seam. For a circumferential seam 30 ft long, the excess cost in fabricating the two-piece construction would be $345.30.

In like manner, a 2 in. plate 108 in. wide involves a cost of 38c per ft of length for the width extra. Since the fabrication cost for joining two plates 54 in. wide is $19.01 per ft of length, to use the two-piece construction would result in a loss of $18.63 per ft of length. These examples illustrate the importance of using the greatest possible width of plate that the width extra will permit.

It will be noted from Fig. 8 that in ⅝ in. gauges and lighter, the one-piece construction is cheaper than the cost of fabrication for all widths. In ¾ in. plate, the one-piece construction is more economical up to 190 in. width, the 1 in. plate up to 185½ in., the 2 in. plate up to 177 in. and the 3 and 4 in. up to 185 in. Curves for intermediate gauges may be plotted as desired.

$7,600 Saving

An analysis of a recent order for twenty 48 in. and twenty 54 in. vessels (one is shown in the finished state in Fig. 9) reveals the importance of using the widest possible plates. After comparing width extras and fabrication costs, the fabricator placed his order as follows:

48 in. Diameter Vessels
20 Plates 171 by 157½ by 1¾ in.

54 in. Diameter Vessels
20 Plates 183 by 176¾ by 1⅛ in.

With two-plate construction, the extra fabricating cost was estimated to average $436 per shell or a total for the 40 vessels of $17,440. With one-plate construction, the extra for the 40 wide plates (at width extras of $1.25 per 100 lb for the 157½ in. wide plates and $1.50 per 100 lb for the 176¾ in. wide plates) and the overweight allowance totaled $9,853. Twenty minutes' calculation thus effected a net saving of $7,587 in the fabrication cost of the 40 vessels.

In addition to the monetary saving, fabricating time on these vessels was reduced by 5,800 man-hours, the equivalent of a 48 hr work week of 121 men. There resulted a corresponding increase in shop productivity without additional expenditure for plant or equipment.

Fig. 9 shows the freedom afforded the designer of the vessels in the location of tube holes and other openings without interference by a circumferential weld.

(To be continued)

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- Will allow tank valve to be opened rapidly without damage to regulator or danger to operator.
- Will prevent unnecessary internal wear in regulator *(as, NOT necessary to release control screw before opening tank valve).*
- Will eliminate possible injury to operator from burstings.
- Will increase life of regulator assembly.

This NEW automatic safety device CUSHIONS the initial BLAST of pressure when tank valve is turned on *(this uncontrolled surge which strikes like a hammer, is the direct cause of most damaged regulators and accidents).* Thereafter pressure slowly equalizes and then CHEK-SHOCK allows a full flow of oxygen.

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FOWLER, CALIFORNIA

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Production-line aluminum resistance welding with the new Westinghouse electronic Condens-O-Weld capacitor-discharge control brings three big advantages:

1. *faster, more accurate*—speeds up to 200 spots per minute provided by the improved full cycle discharge circuit. Costs are lowered, contactors eliminated.

2. *accurate forging pressure* to assure crack-proof welds. Condens-O-Weld forge timing circuit is the most precise available today.

3. *harmful sparking eliminated* by special Condens-O-Weld circuit design.

Reversing contactors, notching relays and primary shorting contactors are eliminated by Condens-O-Weld design. Maintenance is cut sharply. Operation is speeded and welding current is accurately controlled even though line voltage may vary as much as 20%. Sequence is adaptable to all systems of electrode control for welding both heavy and light gauge aluminum.

You can get complete information about the new FC-1 Condens-O-Weld from your nearest Westinghouse office. Or write Westinghouse Electric & Mfg. Co., P. O. Box 868, Pittsburgh 30, Penna.

J-21316

YOU'LL GET 3 BIG ADVANTAGES WITH ELECTRONIC *CONDENS-O-WELD* CONTROLS

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PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

Electronics at Work

On the Job

Corrugated Superstructure

INGALLS Shipbuilding Corp., Pascagoula, Miss., has developed a new type of corrugated pressed-metal superstructure for C-3 ships which is said to eliminate numerous stiffeners and many feet of welding required in flat-plate construction. The corrugated plate itself provides the support that was formerly obtained through stiffeners, eliminating the necessity for welding many points and sections.

Being hoisted in place is the wheel house, 42 ton unit of a new type of superstructure for all-welded 18,000 ton transports developed at the Ingalls Shipbuilding Corp., Pascagoula, Miss. The superstructure is made of corrugated steel panels.

In announcing what is believed to be the first superstructure of this type designed for the C-3, Ingalls officials pointed out that the new design saves time, decreases the man-hour cost and makes assembly easier. This yard, which pioneered in the construction of 100% welded passenger-cargo vessels, recently launched its 57th ship for war service.

Although there is no difference in the overall weight of the deck house when the corrugated plates are used, there is a definite advantage in the methods of constructing and erecting the superstructure. By decreasing the number of steps necessary, the new method makes possible easier assembly and a better job. Emphasis is placed upon streamlining in the design of this new type of deck house. The horizontal lines tend to minimize the height and bulkiness of the superstructure, say officials at the yard.

The corrugated plates are prepared at The Ingalls Iron Works Company's fabricating plants in Birmingham, Ala., 350 miles north of Pascagoula, and are shipped by rail down "the longest assembly line in the world." At Pascagoula, they are assembled and lifted into place atop the 18,000 ton all-welded transports which Ingalls is sending to the war front.

» «

Body Armor Still in Use

PERSONNEL armor of high-manganese steel is being widely used in today's warfare, according to the American Iron and Steel Institute. Leg armor is available for Army engineers who are engaged in clearing ground mines. Airmen are protected against flak by armor for the head and torso and by an apron for the upper thighs. Ground troops are willing to wear armor in small amounts, helmets, for instance.

» «

Welded Feedwater Heaters

EVIDENCE that our Navy's shipbuilding program is still proceeding at a good rate can be obtained from the accompanying picture of 22 feedwater heaters on the delivery floor of the Elliott Co., Jeannette, Pa. Five of the heaters are designed for Victory ships, four will be installed in light air craft carriers, two are for troop ships, and those in the foreground are representative of a number of heaters being constructed for destroyer use.

Welding is necessary for circumferential and longitudinal seams, for fittings welded on to the tanks and for welded straps for lifting the tanks while they are being transported and installed.

» «

Boat of the Future

"STEELCRAFT," a 26 ft. all-steel cruiser which may typify the pleasure craft of the future, is the outgrowth of 12 years of experiments in welded steel construction for small craft conducted by Jack Churchward of Churchward & Co., West Haven, Conn.

"Steelcraft," says Mr. Churchward, "is the result of our aim to give the public the many advantages of steel construction at a reasonable price. The technological advances during the past few years of war construction have paved the way. Now we believe that we have the answer for the boat enthusiast of moderate means who wants a speedy, clean-lined cruiser, easy to handle, inexpensive to buy and inexpensive to maintain."

The hull of the new pleasure cruiser is fabricated from seven pieces of steel, welded and stress relieved. Two pieces form the V-type bottom, two pieces the sides, and one piece each is needed for the deck, the chine and the transom. The construction has the strength of 4 in. of oak and yet is considerably lighter. Being of steel, the interior parts are relatively small, permitting about 15% more usable space than in wood hulls of the same size. All of the underwater fittings are of steel with the exception of the bronze shaft and propeller.

When peace comes, the new streamliner cruiser will be produced in three styles: a runabout, day cruiser sleeping two and sedan cruiser sleeping four. She is to be normally equipped with an 85 hp motor giving a speed of 20 mph but may also be had with two motors and two screws if a speed of 35 to 40 mph is desired.

In the background, two vertical heaters with horizontal storage tanks will be installed by public utilities engaged in domestic power production. All of the others are for naval or merchant ships.

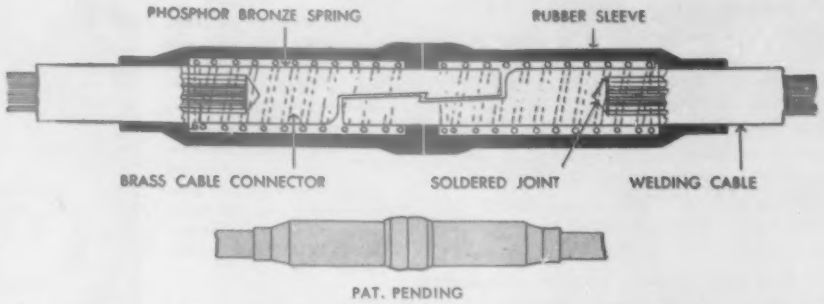
This all-steel pleasure craft developed by Jack Churchward of West Haven, Conn., will be available to boating enthusiasts of moderate means when the war ends.

STEVENS

TUFFLINE

UNIVERSAL WELDING CONNECTOR

SECTIONAL VIEW



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No opposite member to hunt for . . . both ends alike. No loose connections . . . they LOCK. Solid brass connectors . . . will not crush. Carrying capacity greater than that of 2/0 welding cable.

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See this efficient connector in action. Write for further details and request our representative to demonstrate it on your job.

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Anti-Spatter

"FOR BETTER WELDING"

ANTI-SPATTER practically eliminates oxidation—cuts down the amount of slag covering weld. It also fortifies the action of rod coating—less slag, easier to remove. Weld rust practically eliminated.

Easy to apply—simply brush on before welding. After welding, **ANTI-SPATTER** is easy to remove. If surface is to be painted, remove with wet cloth or usual degreasing methods—otherwise use dry rag.

Get speedier and better looking production and save man hours in costly cleaning. **ANTI-SPATTER** is non-inflammable, non-toxic and has no disagreeable odors.

WRITE TODAY FOR DESCRIPTIVE FOLDER ON ANTI-SPATTER

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A new and hotter soldering flux.
No. 5 for Stainless and Monel Metal.
No. 3 for All other metals.
Write for details.

Distributors write us.

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Ideal protection for welders' clothes.
Odorless, low cost, easy to use.
Write for details.

THE WOLFE-KOTE CO.

SHEBOYGAN • WISCONSIN

Alligators to Eat Japs

THE 1,000th "Alligator," an improved amphibious tank, rolled off the Graham-Paige assembly lines at Detroit last month. The Alligator, which is playing a major rôle in the invasion of the Philippines, is the only vehicle able to crawl over sand bars and coral reefs, obstacles which severely handicap other types of landing craft transporting troops to the beachhead. Also, it does not become a "sitting duck" upon reaching the shore but proceeds inland like a tank.

"This is an even more powerful weapon than those which proved themselves in the bitterly contested campaigns on Guadalcanal, Tarawa, Saipan, Tinian, Peleliu, Guam and Leyte," commented Joseph W. Frazer, chairman of Graham-Paige. "The company has completed new assembly lines and expanded facilities for doubling production of the new vehicle, but details cannot be revealed until it has entered combat."

All-welded amphibious tanks like this one are playing a major role in the invasion of the Philippines. Raymond J. Hodgson (left), president of Graham-Paige Motors, E. R. Harrell, vice-president in charge of procurement, and a Navy inspector are shown looking over Alligator 1,000.

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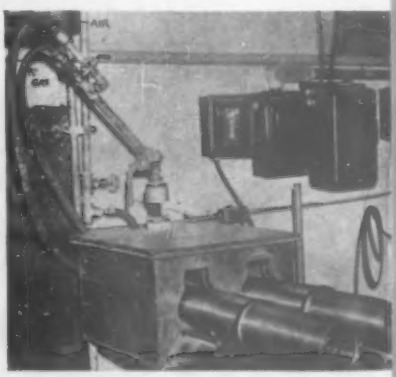
Heat-Treating Oven

By James New

THE accompanying picture shows a small oven I designed for preheating the inner and outer cylinders of certain airplane parts at the Tycoon Tackle Co. of Florida. Two cylinders of chrome-moly steel can be blued in ten minutes with this oven. We preheat to 800-900 F, eliminating all possibility of cracks in the welds.



Courtesy, The Hobart Brothers Co.

Small preheating oven designed by a welder at a Florida aircraft plant. It uses city gas.

The oven was fabricated by welding ½ in. steel plates to form a box 24x24 by 18 in. and mounting the latter on 1 in. pipe legs. The oven has a double wall lined with 1 in. of asbestos sheeting all the way around and a removable lid on which a fixture is welded. An air-pressure gas cap shoots a flame into the oven, hitting a square of fire brick.

The oven is heated by regular city gas. Operated right in the welding department it heats the parts quickly and evenly. It eliminates the use of the large ovens in the heat-treating department, and the production weldor doesn't have to wait for the heated parts.

CESCO

STOPS ARC-WELD GLARE ... PROTECTS WELDERS

● Arc-Weld Glare is *treacherous*.

Like a Tojo, it attacks where it knows welders are unprotected. It seems so unimportant—until the welders' eyes begin to hurt. Back of that pain may be damaged optic nerves.

You can't buy new eyes, but you can beat back Arc-Weld Glare with CESCO safety equipment.

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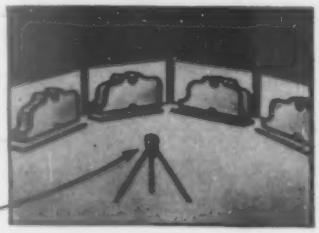

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The Navy's newest welded lift truck. It has a hoisting capacity of three tons and greatly expedites the unloading of landing barges and the movement of strategic war materials into storage and dispersal areas.

Heavy-Duty Lift Truck

OF WELDED construction, the Diesel-hydraulic fork lift truck shown in the accompanying picture was specially designed by the U. S. Navy for unloading landing barges and moving materials into storage and dispersal areas. It has a lifting capacity of 6,000 lb, and the hydraulic tilting mechanism permits both forward and backward tilting of the welded lifting mast.

These trucks are now being supplied to the Navy in quantities by the Whiting Corp., Harvey, Ill.

» «

Outdoor Spot Welding

EXTENSIVELY used in inside manufacturing operations, spot welding has now moved out of doors at The Glenn L. Martin Co., Baltimore, where special portable equipment was recently used on the flight line to attach an added 0.030 in. stainless steel part to the baffle of the exhaust system of a PBM Mariner plane.

A special portable spot welder consisting of a control and transformer unit and an hydraulically operated welding gun was assembled by Martin welding engineers for this job. The control and transformer unit were positioned over the airplane, with the gun in turn suspended from the transformer and control unit, and the welds were then performed by a traveler crane. Power was supplied by a special 500 ft cable feed with an additional 8 ft line running from the transformer and control to the welding gun. Since water cooling was not necessary, the operation was greatly simplified.

Although this is the first known instance of the outdoor use of spot-welding equipment, the welds produced were of production quality.

An added part is attached to the airplane exhaust system baffle on the flight line at The Glenn L. Martin Co., Baltimore. The special portable spot welder was assembled by Martin engineers from standard equipment.

Ask for CMD WELDERS' CHIPPING HAMMERS

A type for every weld cleaning need. Cutting edges stay sharp a long time. Write Department 4W for descriptive circular now!

TYPE CB
Triple Duty
Combines 3 tools in 1—drift, chisel, and removable wire brush.

TYPE A
Drift and Chisel
Made from high-grade tool steel. Especially popular in malleable iron and grey iron foundries for general chipping.

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Same as Type CB but without brush.

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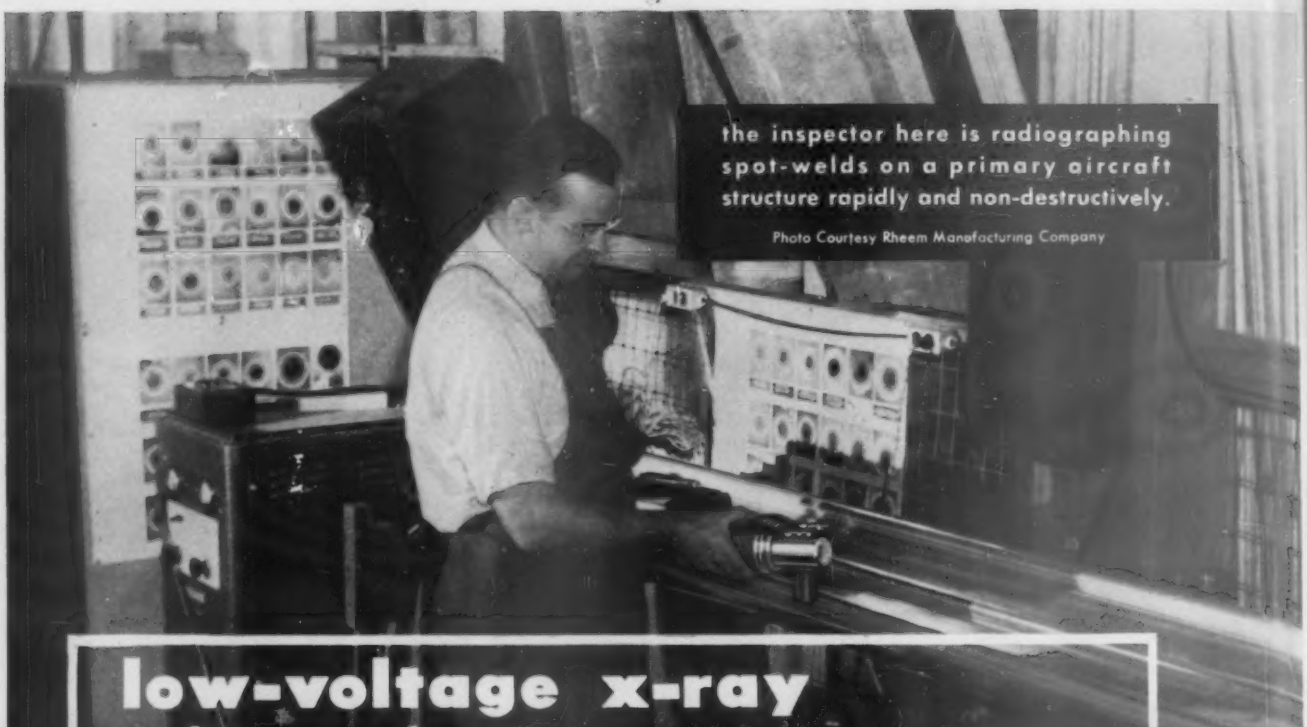
Comparative Weights—Aluminum, Brass and Steel

Thickness or Diam in Inches		Sheets and Plates lb per sq ft			Square Wire and Bar lb per ft			Round Wire and Bar lb per ft		
Fraction	Decimal	Aluminum	Brass	Steel	Aluminum	Brass	Steel	Aluminum	Brass	Steel
1/16	.0625	.88	2.77	2.55	.005	.014	.013	.004	.011	.010
1/8	.1250	1.76	5.54	5.10	.018	.058	.053	.014	.045	.042
3/16	.1875	2.64	8.31	7.65	.041	.130	.120	.032	.102	.094
1/4	.2500	3.52	11.08	10.20	.073	.230	.213	.058	.181	.167
5/16	.3125	4.40	13.85	12.75	.115	.360	.332	.090	.283	.261
3/8	.3750	5.28	16.62	15.30	.165	.519	.478	.129	.407	.376
7/16	.4375	6.16	19.31	17.85	.224	.706	.651	.176	.555	.511
1/2	.5000	7.04	22.16	20.40	.293	.922	.850	.230	.724	.668
9/16	.5625	7.92	24.93	22.95	.371	1.167	1.076	.291	.917	.845
5/8	.6250	8.80	27.70	25.50	.458	1.441	1.328	.360	1.132	1.043
11/16	.6875	9.68	30.47	28.05	.554	1.744	1.607	.435	1.369	1.262
3/4	.7500	10.56	33.24	30.60	.659	2.075	1.913	.518	1.630	1.502
13/16	.8125	11.44	36.01	33.15	.774	2.435	2.245	.608	1.913	1.763
7/8	.8750	12.32	38.78	35.70	.898	2.824	2.603	.705	2.218	2.044
15/16	.9375	13.20	41.55	38.25	1.030	3.242	2.988	.809	2.546	2.347
1	1.0000	14.08	44.32	40.80	1.172	3.689	3.400	.921	2.897	2.670
1 1/16	1.0625	14.96	47.09	43.35	1.324	4.164	3.838	1.039	3.271	3.015
1 1/8	1.1250	15.84	49.86	45.90	1.484	4.669	4.303	1.165	3.667	3.380
1 3/16	1.1875	16.72	52.63	48.45	1.653	5.202	4.795	1.298	4.085	3.766
1 1/4	1.2500	17.60	55.40	51.00	1.832	5.764	5.313	1.439	4.527	4.172
1 5/16	1.3125	18.48	58.17	53.55	2.019	6.354	5.857	1.586	4.991	4.600
1 3/8	1.3750	19.36	60.94	56.10	2.217	6.974	6.428	1.741	5.477	5.049
1 7/16	1.4375	20.24	63.71	58.65	2.423	7.623	7.026	1.903	5.987	5.518
1 1/2	1.5000	21.12	66.48	61.20	2.638	8.300	7.650	2.072	6.519	6.008
1 9/16	1.5625	22.00	69.25	63.75	2.862	9.006	8.301	2.248	7.073	6.519
1 5/8	1.6250	22.88	72.02	66.30	3.096	9.74	8.978	2.431	7.650	7.051
1 11/16	1.6875	23.76	74.79	68.85	3.339	10.51	9.682	2.622	8.250	7.604
1 3/4	1.7500	24.64	77.56	71.40	3.590	11.30	10.41	2.820	8.873	8.178
1 13/16	1.8125	25.52	80.33	73.95	3.852	12.12	11.17	3.025	9.518	8.773
1 7/8	1.8750	26.40	83.10	76.50	4.122	12.97	11.95	3.237	10.19	9.388
1 15/16	1.9375	27.28	85.87	79.05	4.40	13.85	12.76	3.457	10.88	10.02
2	2.0000	28.16	88.64	81.60	4.69	14.76	13.60	3.683	11.59	10.68
2 1/8	2.1250	29.92	94.18	86.70	5.31	16.66	15.35	4.158	13.08	12.06
2 1/4	2.2500	31.68	99.72	91.80	5.94	18.68	17.21	4.662	14.67	13.52
2 3/8	2.3750	33.44	105.26	96.90	6.63	20.81	19.18	5.194	16.34	15.06
2 1/2	2.500	35.20	110.80	102.00	7.34	23.06	21.25	5.755	18.11	16.69
2 5/8	2.625	36.96	116.34	107.10	8.09	25.42	23.43	6.345	19.96	18.40
2 3/4	2.750	38.72	121.88	112.20	8.81	27.90	25.71	6.964	21.91	20.20
2 7/8	2.875	40.48	127.42	117.30	9.72	30.49	28.10	7.611	23.95	22.07
3	3.000	42.24	132.96	122.40	10.57	33.20	30.60	8.287	26.07	24.03
3 1/8	3.125	44.00	138.50	127.50	11.48	36.09	33.27	9.011	28.35	26.13
3 1/4	3.250	45.76	144.04	132.60	12.38	38.96	35.99	9.746	30.66	28.26
3 3/8	3.375	47.52	149.58	137.70	13.38	42.10	38.81	10.510	33.06	30.48
3 1/2	3.500	49.28	155.12	142.80	14.36	45.27	41.73	11.303	35.56	32.78
3 3/4	3.750	52.80	166.20	153.00	16.52	51.97	47.91	12.975	40.82	37.63
4	4.000	56.32	177.28	163.20	18.80	59.14	54.51	14.763	46.44	42.81
4 1/4	4.250	59.84	188.36	173.40	21.22	66.76	61.54	16.666	52.43	48.33
4 1/2	4.500	63.36	199.44	183.60	23.79	74.84	68.99	18.684	58.78	54.18
4 3/4	4.750	66.88	210.52	193.80	26.50	83.25	76.72	20.777	65.39	60.26
5	5.000	70.40	221.60	204.00	29.37	92.24	85.20	23.022	72.45	66.77
5 1/4	5.250	73.92	232.68	214.20	32.38	101.70	93.73	25.381	79.87	73.61
5 1/2	5.500	77.44	243.76	224.40	35.54	111.62	101.03	27.857	87.67	80.79
5 3/4	5.750	80.96	254.84	234.60	38.84	122.00	112.42	30.445	95.81	88.30
6	6.000	84.48	265.92	244.80	42.29	133.52	123.05	33.217	104.53	96.34
6 1/4	6.250	88.00	277.00	255.00	45.89	144.42	133.09	36.042	113.42	104.53
6 1/2	6.500	91.52	288.08	265.20	49.64	156.20	143.95	38.983	122.68	113.06
6 3/4	6.750	95.04	299.16	275.40	53.52	168.45	155.24	42.040	132.30	122.57
7	7.000	98.56	310.24	285.60	57.57	181.16	166.95	45.211	143.28	131.12
7 1/4	7.250	102.08	321.32	295.80	61.75	194.33	179.09	48.498	152.62	140.66
7 1/2	7.500	105.60	332.40	306.00	66.08	207.96	191.66	51.900	163.33	150.52
7 3/4	7.750	109.12	343.48	316.20	70.56	222.68	205.23	55.418	174.40	160.73
8	8.000	112.64	354.56	326.40	75.19	236.61	218.06	59.051	185.83	171.26



the inspector here is radiographing spot-welds on a primary aircraft structure rapidly and non-destructively.

Photo Courtesy Rheem Manufacturing Company

low-voltage x-ray *it works in two ways*

In light-alloy and steel sheet fabrication, low-voltage x-ray works in *two-ways* . . . it permits (a) setting-up close welding technique controls *before* production spot-welding is done, and (b) accurate inspection of welds *after* the operation. The low-voltage radiograph discloses conditions of stress and weakness far beyond ordinary static-shear tests . . . and does it *non-destructively*.

The virtue of low-voltage x-ray lies in the *higher* radiographic contrast obtainable through *minimum* x-ray penetration. The special output characteristics required for such work are all embodied in this new Picker 5 KV to 50 KV Unit. It is rayproof, compact and self-contained. Several design innovations are incorporated, such as the removable tube shown in the photograph above.

In short, the Picker 5 KV to 50 KV is an ideal apparatus for x-ray investigation and inspection of all low-density materials — metals, plastics, fibres, plywood, textiles, to name a few. A Picker representative will be glad to discuss with you its amazing utility and many applications.

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WAITE M'FG DIVISION • CLEVELAND, OHIO

Do You Agree?

If you, as a reader, do not agree with our answers, let us know your thoughts. Your comments and discussions will be published, too.

Life of Welding Lenses

Q—Do arc-welding filter lenses deteriorate with age? If so, over what approximate period of time and to what extent?—*J. L. M.*

A—The general opinion among manufacturers of welding lenses is that they do not know whether lenses deteriorate or not. However, most manufacturers would suggest that if you have any lenses over ten years of age, you should by all means check them to see whether or not they are up to standard. One manufacturer has run tests up to ten years; lens deterioration was found in some instances, but in other lenses none of the filtering value had been lost. It seems impossible to generalize authoritatively, inasmuch as there are frequent filter-value variations between lenses which come from the same glass melt.

» «

Hard-Facing Churn Drills

Q—Is it possible to hard-face churn drills? Well drillers in my neighborhood drill deep-water wells, sometimes through limestone or granite formations, and would like to hard-face their drills.—*E. M.*

A—It is rather difficult to hard-face churn drills to any degree of satisfaction. A drill of this type is continually subjected to impact, which causes the extremely hard deposited metals to chip before they have materially increased the life of the drill. If you want to try to hard-face such drills, possibly you would obtain best results from a self-hardening type of hard-facing material—material of the type that will work harden. This will probably produce as satisfactory a drill as any type of hard-facing.

In hard-facing churn drill bits, a bead of hard-facing should be applied around the edge of the bit so as to maintain the proper drill clearance. The drill point, the spot of greatest wear, should also be protected by hard-facing.

» «

Weldable Metals

Q—What metals are weldable?—*A. B. J.*

A—All of the common metals, most of the precious and semiprecious metals, may be joined to each other by one or more welding processes. In many cases it is also possible to join dissimilar metals by welding. When you weld dissimilar metals, however, always use a welding rod having properties similar to those of the metal of the lowest melting point.

DESIGNED • ALLOYED • FABRICATED

For SUPERIOR WELDS

TITAN Bronze WELDING RODS

Only the purest raw materials go into the manufacture of Titan Bronze Welding Rods. Strict laboratory control of mixtures and casting temperatures and Titan's exclusive Double Deoxidation* process combine to assure the best possible welds.

Titan Bronze Welding Rods offer the following advantages:

1. *Uniform and easy tinning.*
2. *Low melting point.*
3. *Double Deoxidized* to produce ductile, high strength and dense nonporous welds.*
4. *Low fuming—a comfortable atmosphere for the welder.*
5. *Good machinability of the deposited Bronze alloy in the weld.*
6. *Corrosion resistant.*

For UNIFORMITY — DUCTILITY — SOUNDNESS and STRENGTH specify Titan Bronze Welding Rods. Complete information available on request.

**Double Deoxidation removes all occluded and dissolved gases picked up in melting which increases ductility and reduces fuming to a minimum.*

Titan

METAL MANUFACTURING CO., BELLEFONTE, PA.

NEW YORK • CHICAGO • SAN FRANCISCO

Quality Alloys By Brass Specialists

Brass and Bronze Rod • Forgings • Die Castings • Welding Rods

New Products to Use

Welding Resistor Unit

★ Doubled and tripled welding capacity is said to have been achieved in major shipyards and industrial plants through

Model C "Tuffline" resistor unit. It is built to withstand the rough usage encountered in shipyard work.

the installation of Stevens "Tuffline" portable resistor units. Their use enables two or three men to operate simultaneously on production welding from one standard single-operator 300 amp welder of the motor-generator type. When two or more resistor units have been properly connected to the welding generator, each operator's heat may be varied without affecting the current supplied to the other weldors. On a 400 amp generator as many as five men can work at the same time, using these units.

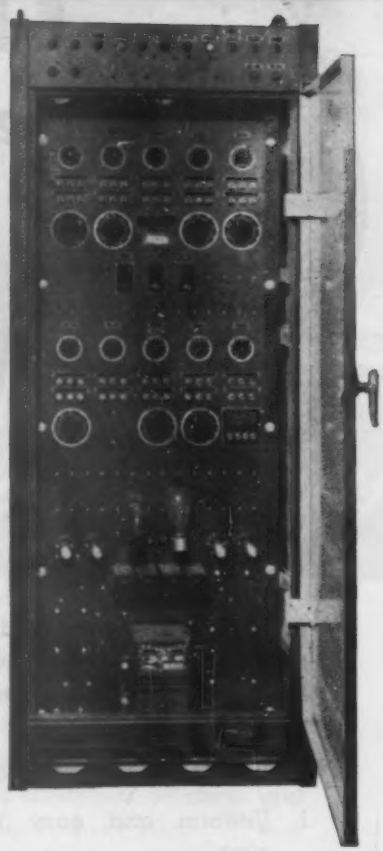
The new Model C "Tuffline" weighs 40 lb and has an overall length including panel of 21 in., a width of 11 in. and a height including handle of 16 in. The frame is made of ⅛ by ¾ by ¾ in. angle iron, the legs of ⅛ by 1 by 1 in. angle iron, with fully mitered, continuously welded joints. Sides, bottom, end and gables of top are of heavy sheet metal. The resistor coils are made of flat nichrome ribbon wound on porcelain blocks placed on 15 gauge steel barriers. All conductors are No. 2 and No. 4 soft-drawn copper wire, soldered to coils with No. 1 hard silver solder. **C. H. Stevens and Co.**, 15 Ann St., So. Norwalk, Conn.

» «

Weld and Sequence Timer

★ A new weld and sequence timer for providing the various time and current adjustments necessary for welding heavy sections of air-hardenable steels is announced by the industrial control division of the **General Electric Co.**, Schenectady. Known as Type CR7503-F170, this timer is especially designed for use with an ignitron contactor and a heat-control panel, though it can be used with most spot-welding controls of this manufacture which include the phase-shift method of heat control.

Operating from 230/460/575 volts, 60 cycles, the new control adjusts the time of current flow and its magnitude for



G-E CR7503-F170 sequence control and program timer. This view shows indicating lights, time and current adjustments, pressure period adjustment and tubes.

preheating, welding, grain refinement and tempering. Other adjustments control the time for chilling the weld nugget following the weld and grain refinement periods. The control consists of nine time intervals, seven independent heat adjusters, two pressure interval timers, one squeeze timer, one hold timer and provisions for a two-stage foot switch. A minimum number of tubes (six) are used to give the multiple operations required.

» «

Electrode Holder

★ The "Mor-Weld" is a new type of electrode holder with a jaw cover of heat-resisting plastic. The new jaw cover is claimed to outlast conventional types, lessening the necessity for the changing and servicing of this part. Another innovation is a grip which holds all rod sizes and enables the electrode to be consumed down to a stub without the necessity of bending it. The lever-action jaws can be replaced in less than a minute

"Mor-Weld" electrode holder. Its features are plastic jaw covers, lever-action jaws and a handle made of wear-resisting plastic.

without tools; there are no pins nor bolts which allows for fast servicing and cleaning. **Pacific Engineering Corp.**, 3123 S. Fernando Road, Los Angeles 41.

» «

New 301A "Duralite" safety goggle is at left; previous model at right. Major improvement is a newly designed eyecup said to provide greater eye protection, ventilation and comfo

Safety Goggle

★ An improved "Duralite" safety goggle designed for workers who face the hazards of flying objects is announced by **American Optical Co.**, Southbridge, Mass. Major improvement is a newly designed eyecup which is considerably larger in area and provides a wider angle of vision than the previous cup. Shaped separately to fit the contours of the right and left eye, the cups fit snugly against the face and protect the eyes from objects striking from the sides, top or bottom. They are non-conductors of both heat and electricity.

The nasal section and enlarged facial contact roll of the goggle conform to the shape of the face, while the smooth round edges of the eyecups fit snugly and stay in place comfortably. Greatly increased ventilation is provided by air channels in the edge of the eyecups and by extra side perforations. A natural draft is produced behind the lenses, reducing the possibility of fogging.

The new 301A "Duralite" goggle is supplied with either 50 mm "Super Armorplate" lenses in white glass or 51 mm lenses in Calobar medium, dark or extra dark shades. If desired, "6-curve Super Armorplate" lenses can also be furnished.

Key TO SUCCESSFUL UNDERWATER CUTTING

Success of salvage and construction operations at Pearl Harbor, on the Normandie and in scores of liberated ports around the globe have rested largely on the technique of underwater cutting and welding that bid fair to play an important role in the peace-time world.

As a pioneer in flame cutting and welding, Air Reduction has been in the forefront in the development of underwater cutting equipment. The Airco Style 9116 Underwater Cutting Torch is an example of Air Reduction's contribution to the success of these ventures.

The torch is short—only 12 inches long—to reduce the "kick" when the cutting oxygen jet is released against surrounding water. It is furnished with either 75° or 90° head.

The metal shield which surrounds the tip performs a dual function: 1. It provides a pocket for an "artificial atmosphere" of compressed air which displaces any water around the cutting flames. (An extra hose connection is provided on the torch for the compressed air.) 2. The "feet" on the end of the shield hold the cutting flames at the correct distance from the metal surface.

This Airco torch, key to scores of "miracle" exploits of Navy and Seabee divers, is now available for underwater salvage and construction jobs you may encounter. And the knowledge and experience of Airco's Applied Engineering Division are at your call to insure the success of such jobs.

You will find much of interest and value to that success in Airco's new publication, "Underwater Cutting and Welding". It's free. Mail the coupon today for your copy.

WE

Air Reduction Sales Co.
60 E. 42nd St.,
New York 17,
New York

Gentlemen:

Please send me a copy of the booklet "Underwater Cutting and Welding".

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Saving Metal, Money and Time · *With Conservation Welding*

Incidental to war production an increasing number of worn ferrous equipment parts—the sort which used to be summarily scrapped — have been salvaged for further useful life with Amsco Welding Products. This practice has saved large amounts of scarce metals and obviated the difficulties and delays attending the procurement of new parts. At the same time, many additional establishments have become familiar with the substantial reductions in replacement costs afforded by Amsco Conservation Welding.

W-4. A rehabilitated manganese steel 128" crusher mantle. Amsco Nickel-Manganese Steel Filler Bars were swaged by hand to produce the proper contour, and were tacked onto the mantle, using Amsco Nickel-Manganese Steel Electrodes. Each bead was peened thoroughly. Total rehabilitation cost was $275.00.

Worn equipment parts which have been restored with highly wear-resistant Amsco welding materials often give as long service as new parts, and at considerably less cost. Substantial savings have also been obtained by hardsurfacing new parts with Amsco Welding Products which, having far higher wear resistance than the body metal, afford greatly increased service life. As replacement costs will assume added importance in the postwar period, *conservation welding* will be still more widely practiced.

A few examples of Amsco Conservation Welding are pictured. Others, with full information on Amsco Welding Products, are shown in Bulletin 941-W. Send for your copy.

W-103-B Sprockets from a tractor which were put in service at the same time. The one on the left had been rebuilt with Economy Hardface; the one on the right was a brand new sprocket. Note that the new one is worn to such an extent that it was necessary to resurface it with Economy Hardface, while the welded sprocket needed no repairs whatsoever.

10-C This brick machine auger tip served over a year after being built up with Amsco Nickel-Manganese Steel Rod and hardsurfaced with Amsco No. 459 Rod, as compared to the usual performance of only a few months before replacement. A new part costs $45.00. Total salvage cost was $31.00.

Amsco
AMERICAN MANGANESE STEEL DIVISION
Chicago Heights, Illinois
FOUNDRIES AT CHICAGO HEIGHTS, ILL.; NEW CASTLE, DEL.; DENVER, COLO.; OAKLAND, CALIF.; LOS ANGELES, CALIF.; ST. LOUIS, MO.
OFFICES IN PRINCIPAL CITIES

AMERICAN Brake Shoe COMPANY

A-C Welder

★ A general-purpose a-c welder, No. G-225, is offered to meet the requirements of postwar welding by the **Hampton Electric Mfg. Co.**, 1105 Pine Place, New Kensington, Pa. It will weld materials from the thinnest sheets to the heaviest plates and has a stabilizer to counterbalance the welding current and voltage, thereby permitting a good weld to be made even on rusty or greasy material, states manufacturer.

Hampton G-225 a-c welder. It has been designed to meet the varying requirements of postwar welding.

The G-225 handles 1/16 to 1/4 in. electrodes, operates on either 220 or 440 volts and has a capacity of 30 to 300 amp. Between minimum and maximum settings, welding heats can be obtained in increments of 1/2 amp if desired. A thermostatically controlled, arcless cutout protects the welder against overload for a long period of time.

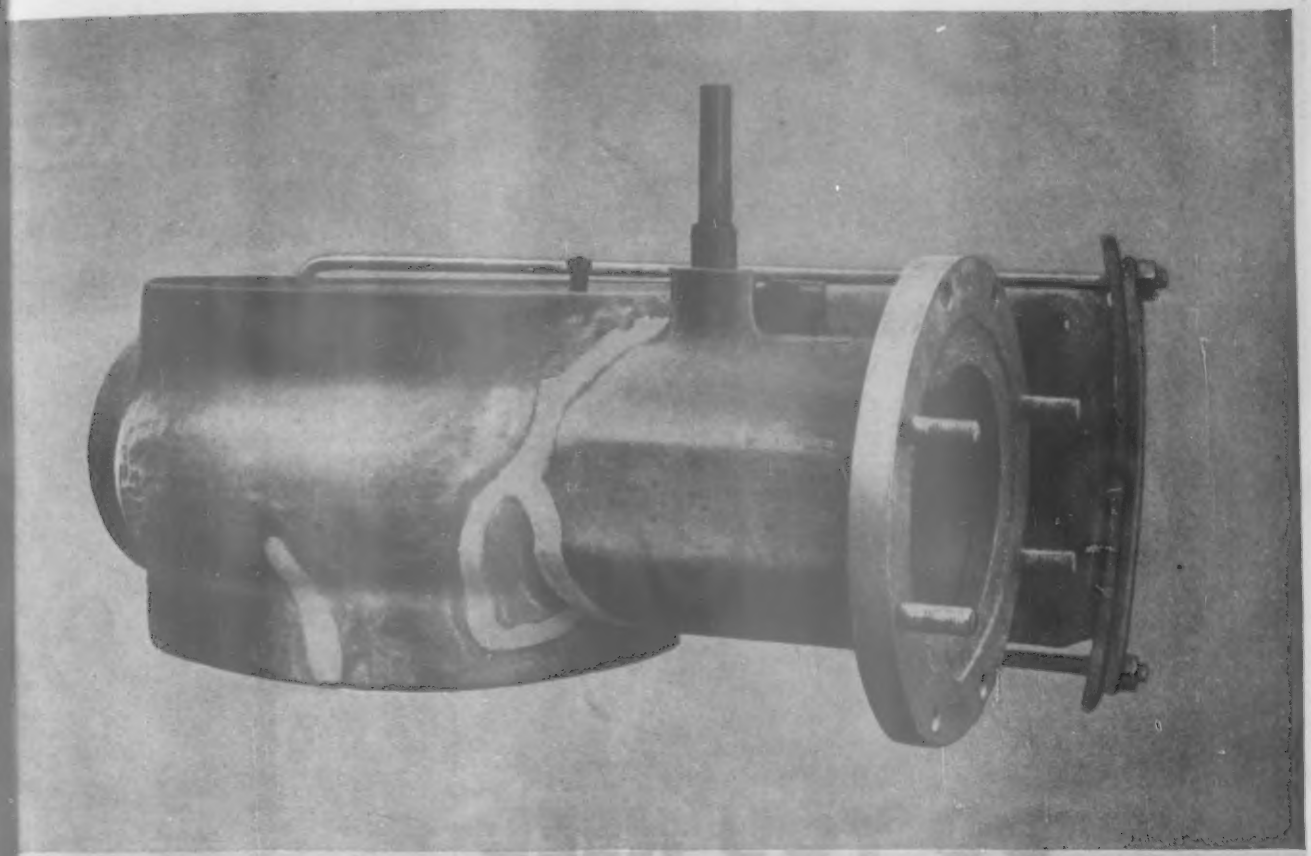
» «

Electrode Kit

★ Marquette's new "Weld-All" electrode kit contains a generous supply of eleven types of rods to cover practically the entire field of electric welding. In addition, a rod chart and instruction book give complete data on the proper use of each type of electrode. The electrodes included, all of Marquette manufacture, are:

Eleven different types of electrodes in this handy kit.

Type 151, all position; "Blu-Rod" No. 40 for cast iron; "Cast-Rod" No. 42 for machinable welds on cast iron; "Nicol-Rod" No. 44 for machinable cold welds on cast iron (also welds steel, copper to cast iron and Monel); "Bronz-Rod" No.



10 hours of Tobin Bronze Welding Restores Oil Engine to Service

CRACKS in the crank case of this crude-oil engine spread, in spite of the use of clamps, until they practically encircled the casting.

Replacement would have been costly and, even more important, would have involved downtime running into weeks or perhaps months. Instead, repair welding with Tobin Bronze* Rod was undertaken. In ten hours the casting was repaired, ready for reassembly and the resumption of its important function.

More and more, as such instances of time and money saving pile up the evidence, industries of all types and in all parts of the country are accepting the slogan "Don't scrap it...bronze-weld it!" Before you replace machinery that seems hopelessly damaged, consider repair welding with Tobin* Bronze or Anaconda* "997" Low Fuming Rods. 45107

*Trade Marks Reg U. S. Pat. Off.

THE AMERICAN BRASS COMPANY
Subsidiary of Anaconda Copper Mining Company
General Offices: Waterbury 88, Connecticut
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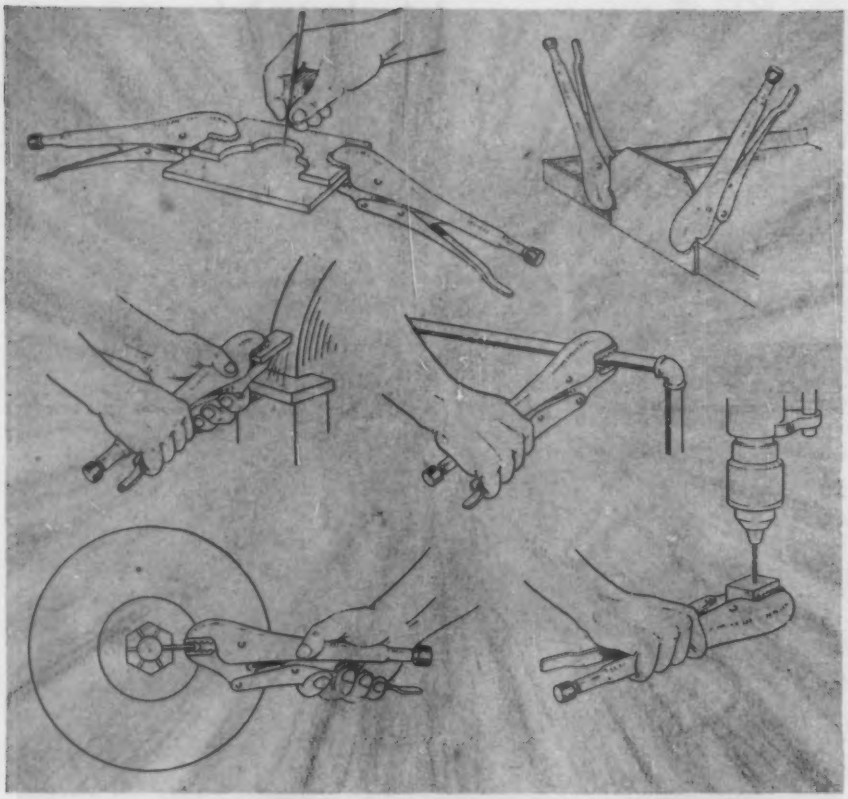
BUY WAR BONDS . . . Keep buying them, Buy them for Keeps

ANACONDA *Anaconda Welding Rods*



DO YOU NEED *A Handy Tool* THAT WILL DO THINGS LIKE THIS?

★ It's the new Vise-Wrench—that combines the portability and convenience of ordinary pliers with the powerful locking grip of a vise. While work is being held, both hands can be free for operations. When completed, work can be released instantly.

Known as Model VG-10, the Vise-Wrench is 10 inches long and weighs 18 ounces.

Normal hand grip can attain a clamping pressure at the jaws up to 1 ton.

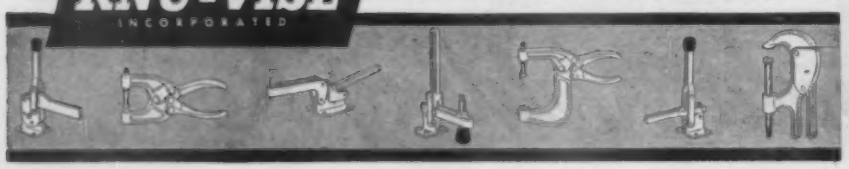
Jaws are alloy steel forgings with machined teeth (properly heat treated for greatest wear resistance) welded to stamped body construction (also heat treated).

Send for new catalog.

BUY WAR BONDS

KNU-VISE INCORPORATED

1336 PLUM STREET, DETROIT 16, MICH.
4328 SAN FERNANDO RD., GLENDALE, CALIF.

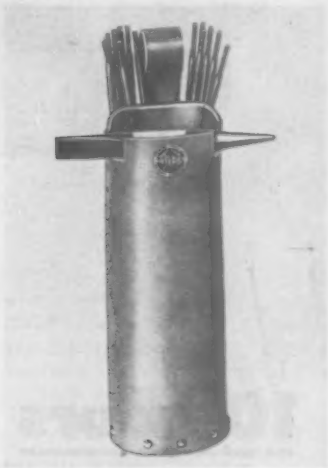


61 for brazing; "Hycarb-Rod" No. 110 for building up worn steel parts (moderate abrasion and shock); "Hard-Rod" No. 450 for hard-facing (medium impact and abrasion); "Mang-Rod" No. 250 for work-hardening and hard-facing (severe impact and abrasion); 'Tool-Rod" No. 650 for high quality cutting edges on tools, etc.; "Stain-Rod" No. 650 for stainless steel or cast iron or manganese steel repair; "Aluminum-Rod" No. 80 for electric or gas welding of aluminum. **Marquette Mfg. Co., Inc.**, 307 E. Hennepin Ave., Minneapolis 14.

» «

Electrode Carrier

★ When the weldor strews his stock of electrodes over the floor, chipped and cracked flux coating inevitably result,



Atlas "Dual-Case," a carrier for welding electrodes and a weld-cleaning tool.

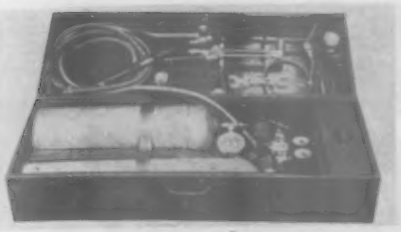
causing many electrodes to be scrapped unnecessarily. The Atlas "Dual-Case" is designed to prevent this by providing the weldor with an electrode receptacle which he can suspend from his belt. An extra division of the case is also provided for carrying a weld-cleaning tool so that both electrodes and chipping hammer will be conveniently at hand when they are wanted.

The "Dual-Case" is made of heavy harness leather, riveted for permanent construction. It measures 12 in. high by 3½ in. in diameter and holds 8 to 10 lb of electrodes. A broad loop is provided for attachment to the weldor's belt. **Atlas Welding Accessories Co.**, 14824 Wyoming Ave., Detroit 21.

» «

Welding Outfit

★ A handy portable oxy-acetylene welding outfit, No. 45-W-12, is being offered by **The Lintern Corp.**, 60 Lincoln Ave., Berea, O. Instead of large oxygen and acetylene cylinders, it uses a Prestolite tank and a small oxygen tank that are good for at least 12 hours of continuous welding on light-gauge metal. The equipment is neatly arranged in a steel cabinet, 37 in. long, 13 3/4 in. wide and 9 in. deep, which weighs 117 lb complete



Lintern portable oxy-acetylene welding outfit. Tips will do welding or brazing on plates up to 3/8 in., cutting on plates up to 1/2 in.

with tanks. The following articles are included:

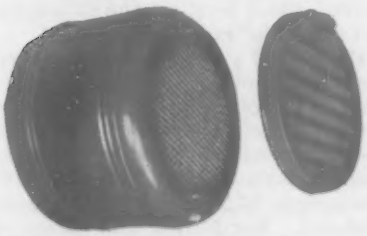
One oxygen cylinder, torch, cutting attachment, yoke, cutting tip, welding tip, pig-tail, wrench, No. 1620 gauge, 12½ ft of 3/16 in. oxygen hose, 12½ ft of 3/16 in. acetylene hose, goggles, leak detector, No. 10 pressure regulator for B tank of Prestolite. The latter can be secured from the local acetylene distributor on a rental basis. The "pig-tail" (charging line) is used for recharging the oxygen tank from the customary large cylinders.

The tips furnished, states manufacturer, permit welding or brazing to be done on plates up to 3/8 in. thick and plates up to ½ in. thick to be cut. Use of this outfit, which can be handled by one man, will save the hauling of large cylinders and long hose lines to do relatively small jobs.

» «

Welder Filter and Hood

★ A redesign of the Badger filter and a new "Weatherhood" that is snap-locked into position on the filter unit are an-



Badger filter. It safeguards motor-generator welders from the entrance of dust and other particles harmful to moving parts.

nounced by the Badger Corporation. The filter when installed on a generator-type welder stops dust, grit, mill scale, welding slag, foundry sand and other particles harmful to moving parts. Its use, claims manufacturer, avoids many expensive repairs, assures longer brush life, increases rotor life and minimizes welder shutdowns

The "Weatherhood" is designed for outside installations or wherever the welders are subject to heavy moisture. It will keep snow, sleet, rain or atmospheric salt moisture out of the machine interior, according to manufacturer. Both of these products are illustrated and described in a recently published four-page folder available from Badger Corp., 325 East Brown St., Milwaukee 12.

Let the Pioneers of

TOOL and DIE WELDING ELECTRODES

Help You Effect Savings in Your Plant!

You can save many man hours, conserve material and minimize production delays. Tool steel welding can be used profitably in any plant using tools and dies. Here's how it can be done:

1 REPAIRING DIES . . . Existing units that may fail in operation can be welded, either partially or wholly, resulting in a minimum of "down-time".

2 COMPOSITE FABRICATING . . . Die units can be compositely fabricated, when practical, by welding, resulting in numerous advantages.

3 CORRECTING DESIGN . . . Welding facilitates making changes in contour, corners or edges during die "try out" or "change over" periods.

4 RECTIFYING ERRORS . . . Welding permits the correction of errors made in tool and die manufacturing resulting in great savings.

For complete information write for technical catalog

Welding Equipment & Supply Co.

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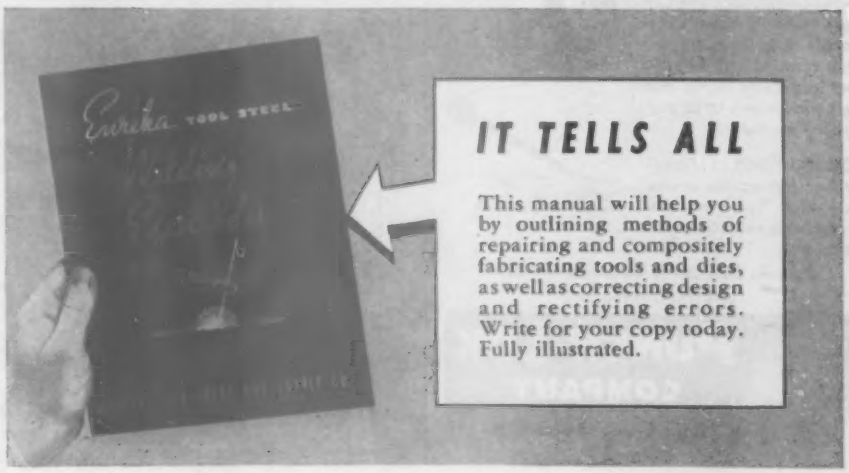

IT TELLS ALL

This manual will help you by outlining methods of repairing and compositely fabricating tools and dies, as well as correcting design and rectifying errors. Write for your copy today. Fully illustrated.

It's a Cinch to Splice Welding Cable

with PUNCH-LOK Streamlined BANDING METHOD

No Soldering • No Rigid Connections • with Punch-Lok

(1) Cut ends square, strip and place sections together. (2) Tension Punch-Lok band around the joint with Loking Tool. (3) Pein corners of lock smooth. (4) Insulate joint with tape or other means. Quickly and easily applied and no normal pull strain can tear it loose.

Punch-Lok is versatile. It connects hose, stops leaks in air, steam or water lines, reinforces and mends splits in cross-arms, ladder rails, poles, etc. Ties rigid conduit or flexible cable to pipe lines or girders, ties ends of wire or manila rope to prevent fraying—wherever a tight band can be used to connect, mend, splice or reinforce. It's easy, fast, economical, safe!

CLAMPS . . . Made of flat, high tensile galvanized steel or Everdur, which is a corrosion resistant copper base alloy. All clamps are double wrapped. Available from ¾" to 48" I.D. Any large size clamp can be pulled down to fit any smaller diameter.

LOKING TOOL . . . Sturdily constructed to assure long life. Locks all size clamps with a sufficient tensional pull.

Write for Descriptive Catalog and Name of Local Distributor

PUNCH-LOK COMPANY

Dept. E, 321 N. Justine St.
Chicago 7, Illinois

Helpful Literature Just Published

The following reviews are of recent publications of interest to those in the welding industry. Unless otherwise stated, they may be obtained without cost by writing to the manufacturers listed.

Pipe-Line Booklet

A 12-page, letterhead-size booklet, "Oxy-acetylene Pipe-Line Installations," gives a concise description of typical oxy-acetylene pipe lines for various-sized industrial plants and discusses in detail the advantages of gas piping systems for welding, cutting and other flame processes. Details are given on pipe sizes, central depot location, station outlets, safety devices and other pertinent data. Schematic diagrams of piping layouts for plants ranging from railroad shops to aircraft welding departments are also included. **Air Reduction Sales Co.**, 60 East 42nd St., New York City 17.

» «

Corrosion Information

In the belief that a good working knowledge of corrosion is the best possible means of securing maximum equipment life and minimum maintenance costs, The International Nickel Co. has prepared a 56-page, 11 by 8½ in. publication entitled "Corrosion." This gives a convenient and comprehensive analysis of corrosion principles for both the practical man and the technician.

The opening section explains how corrosion processes work and discusses all of the known factors that influence their action: acidity of solution, oxidizing agents, temperature, agitation, films, inhibitors, surface condition, stress, heat treatment, welding, concentration cells and galvanic action. Graphs, drawings and tables illustrate these discussions.

The middle section, a detailed review of testing methods, tells how service conditions are simulated in corrosion research. Included is a description of the construction and use of the spool-type specimen holder by means of which the comparative behavior of several metals and alloys can be determined simultaneously under actual operating conditions.

The corrosion-resisting characteristics of Monel, nickel and Inconel are analyzed in the closing section of the book. Tables list nearly 500 typical corrosive media with which these alloys have been successfully used and report the results of more than 120 specific tests made under varied conditions in 44 common corrosive agents.

"Corrosion" will be sent to equipment designers, engineers or other metal users on request to **The International Nickel Co., Inc.**, 67 Wall St., New York City 5.

» «

Electron Microscope Booklet

Operation of the recently developed electron microscope is clearly explained in a 16-page, 6 by 9 in. booklet, "The RCA Electron Microscope." Diagrams depict the action of the "magnetic lenses," which bend a beam of electrons in exactly the same manner as the optical lenses of a conventional microscope bend a beam of light. Among the many applications of the electron microscope is the study of surfaces of metals by the so-called "replica" method. This is explained in the text and typical microphotographs (7,500X and 9,000X) are reproduced. For further information address Dept. 255-A, Electron Microscope Section, **Radio Corporation of America**, Camden, N. J.

GET THE IMPROVED SUPER DRILL GRINDER

Grinds round shank drill points from No. 42 to 1 1/16" diameter. Grinds old drills like new. Grinds short, medium and long twist drills from 1½" to 11". The grinder that gives a rounded point!

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The ideal tool for the hobbyist! Available now—buy it today.

C-F POSITIONERS

WHEN "POSITION" COUNTS MOST

On automatic welding jobs, like the one illustrated here, position counts "most", and with the C-F Positioner (with 6 sizes, and capacities to 30,000 lbs.) the tables tilt to 135° beyond horizontal and rotate 360°, all under push button control. The exclusive C-F Variable-Speed Control gives table rotations ranging from 0 R.P.M. up for all sizes. For "quick change" of position, for greater time saving and efficiency, for lower costs and greater safety to men and materials, specify C-F Positioners for all AUTOMATIC and production welding operations.

Write for Bulletin WP-22

CULLEN-FRIESTEDT CO.

1309 S. KILBOURN AVE.
CHICAGO 23, ILLINOIS

Economize in '45

USERS of acetylene gas for welding and cutting spent around 85 million dollars for acetylene in 1944. That's a lot of money in anyone's language—spent by the many thousands of users of acetylene in cylinders.

And if all of those users had Sight Feed Acetylene Generators their acetylene costs would have been reduced 50% to 75%. Yes, their savings would have averaged at least two-thirds—a grand total of over 56 million dollars saved.

Why not order *your* Acetylene Sight Feed Generator today—and *economize in '45!*

THE *Sight Feed* GENERATOR COMPANY • SALES: RICHMOND, IND. • FACTORY: W. ALEXANDRIA, O.

Aircraft Instruction Book

Continuing its program of formulating training standards for welding operators, the American Welding Society has published "Part B-1: Oxy-acetylene Welding of Steel Aircraft" as a part of the AWS "Code of Minimum Requirements for Instruction of Welding Operators." In the form of a convenient 6 by 9 in. bulletin, both primary and advanced courses are outlined, and welding exercises and lectures are prescribed for each. These courses follow the form of "Part A: Arc Welding of Steel," which has been widely used by the U. S. Office of Education in training welding operators under the National Defense Program. A trainee who successfully completes a course given in Part B-1 should be able to pass the qualification tests required for Class A and Class B Army and Navy aircraft welding operators.

Data given in the several appendices include: accessory equipment for welding schools, testing apparatus and its applications, recommended safety rules, classification and use of welding rods, suggested exercises, suggested form for recording trainee progress, suggested form of record card and a selected, annotated bibliography of publications on oxy-acetylene welding. Copies of the manual may be obtained at a price of 50c each (discounts for group quantities) from the American Welding Society, West 39th St., New York City 18.

» «

Acetylene Generator Bulletin

Both portable and stationary types acetylene generators are illustrated a described in a four-page, letterhead-si bulletin, "Airco Acetylene Generator This bulletin features the new Type "I portable generator, a model incorp rating a water-circulating system a enlarged radiation space between t carbide hopper and water level to eli inate the "hot belt." Portable mode in 15, 30 and 50 lb sizes and stationa models in 300 and 500 lb sizes are al shown; these deliver from 30 cu ft gas per hr (15 lb model) up to 1,0 cu ft per hr. **Air Reduction Sales C** 60 East 42nd St., New York City 17.

» «

Mallory Catalog

A new 36-page, letterhead-size catal on Mallory resistance-welding electrod and alloys has just been issued. Th book lists various sizes and styles spot-welding tips and tip holders, a t dresser, adapters, seam-welding whee and dies for flash, butt and projecti welding. A chart of recommended el trode materials for spot welding is al given. Another feature is a comple list of "Do's and Don'ts" for: (1) resi ance-welding electrodes and holders, resistance-welding machines and oper tions and (3) resistance-welding timi equipment.

Stock sizes of Mallory alloys, th various applications and typical physi properties are also included. **P. R. Ma lory & Co., Inc.**, 3029 East Washingt St., Indianapolis 6.

» «

"Research in Action"

To mark its fifteenth year of servi to industry, **Battelle Memorial Institu** Columbus, O., has published an attra tive 60-page, letterhead-size booklet "Research in Action." This book emplo a skillful blend of text and picture portray the research achievements Battelle in the fields of minerals, fue ferrous and non-ferrous metallurgy, a loys and heat treatment, high-temper ture metals, welding, etc.

Of particular interest to the reade of this journal are the new developmen in welding. "Constructive work has be done," the book states, "on the develo ment of welding electrode coatings, a on studies of the best electrodes f aircraft welding. Methods for accura ly measuring the weld crack-sensitivi of high-strength low-alloy steels ha been développed and are being used improve the welding quality of aircra and ordnance steels. The static a fatigue strengths of metal-arc-welde gas-welded and flash-welded joints alloy steels have been investigated establish safe limits in design."

FAST, FLAWLESS WELDS
NO "MAGNETIC BLOW"
A TAP FOR EVERY HEAT
A HEAT FOR EVERY JOB
LIGHT GAUGE METAL TO HEAVY CASTINGS
ALL-ASBESTOS INSULATION
NO DIALS, LEVERS, ETC.
10 MODELS 125-400 AMPS.
COMPLETELY EQUIPPED
LOW INITIAL COST
LOW OPERATING COST
LOW MAINTENANCE COST
SO MUCH
for so little
WITH
MARQUETTE
REGISTERED U.S. PAT. OFFICE
A.C. ARC WELDERS
You don't need a slide rule to recognize the many advantages of putting Marquette A.C. Arc Welders to work in your shop.
The super-efficiency of the Marquette transformer has no equal in converting the always available, low cost power line A.C. to the smooth, steady flow of matchless welding power. The many accurately controlled heat stages supply the correct power for easy, fast, strong and uniform welds on everything from light sheet metal to heaviest steel structures. The added A.C. feature of balanced polarity assures adequate penetration and perfect metal control . . . both at the same time! You'll get more welding jobs out, in less time . . . and at far less cost with "top notch" MARQUETTE Welders.
BUY THE BEST . . . . BUY MARQUETTE
Send for free, 24 page, illustrated booklet
MARQUETTE MFG. CO., Inc.
Minneapolis 14, Minn.
MARQUETTE
REGISTERED U.S. PAT. OFFICE
a.c. arc welders

Before

INTRODUCING TIP CLEEN

A NEW MAGIC CLEANER FOR WELDING TORCH TIPS

Due to the extreme heat of the torch, impurities and deposits settle in the nozzle and in time clog it up.

Tip Cleen Removes these deposits Easily . . . WITHOUT HARM TO THE TIPS.

Tips already thrown into the discard because their clogged condition made cleaning seem impossible Have Been Cleaned Easily With Tip Cleen.

Just Think Of The Economy . . . Not Only In The Number Of Tips Saved But Also In Labor And Delays!

Save-------Time--------And--------Money

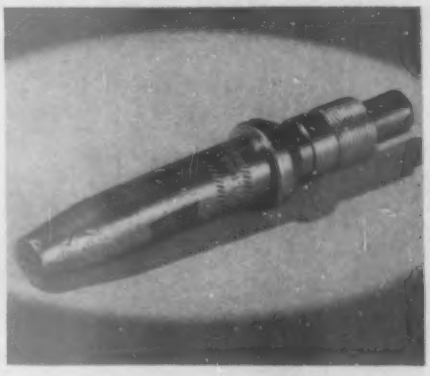
After

New, Simple, Easy . . . No Harm to Tips

Old methods frequently used Strong and Injurious Acids . . . Tip Cleen Is absolutely Non-injurious to the tips. Drills have been used, but they injure the passages by breaking off and by changing the tapered tolerances.

To clean Tips by this new method, merely heat Tip Cleen to 150 degrees Fahrenheit, drop in tips for four hours, remove tips and rinse in cold water. THEY WILL BE AS CLEAN AS NEW . . . No impurities will remain in the air passages . . . it will shine like a new rifle barrel.

Be Convinced At No Cost To Yourself . . . Send For A Free Sample Today.
Weight approximately 50 lbs. per shipping case. Packed in gallon containers 4 to the shipping case.



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Makers of CORE CLEEN, CARBON CLEEN, GREASE CLEEN

EASY-FLO fabricated Air Speed Indicator Part. 6 joints in upper assembly brazed simultaneously—then 10 in lower. EASY-FLO rings preplaced at all joints.

EASY-FLO RINGS

"WED" METALS TOGETHER FOR KEEPS

It's the fashion today to join metals with **preplaced** rings of EASY-FLO silver brazing alloy wire—first, because low-temperature EASY-FLO means fast, reliable, low-cost brazing—second, because preplacing the alloy speeds production, gives accurate control of amount of alloy and assures uniform distribution throughout a joint—and finally, because metals joined by EASY-FLO will never be parted by vibration, shock or extremes of temperature. They're **one for keeps.** START NOW to get the benefit of EASY-FLO's speed, reliability and economy in your metal joining operations present and future. **BULLETIN 12-A** tells you how. Write for your copy today.

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WAREHOUSES

Chicago, Ill., 3348 S. Pulaski Rd., Phone Crawford 4400
Detroit, Mich., 5151 Wesson Ave., Phone Tyler 6-3000
St. Louis, Mo., 4565 McRee Ave., Phone Grand 5255

DISTRICT OFFICES

Milwaukee

Guide to Labor Relations

The "Foreman's Guide to Labor Relations" was prepared by the **U. S. Department of Labor,** Division of Labor Standards, in response to requests from plant management for material to guide supervisors in handling labor problems. The Guide, a 36-page, 6 by 9½ in. bulletin, was written primarily to provide the foreman with a background in the field of labor relations and give him a better understanding of the position he holds as a representative of management. The material is divided into four sections: I. Introduction—the Foreman's Job; II. Management, Supervision and Labor Relations; III. The Foreman and Collective Bargaining; IV. The Foreman and the Individual Worker.

» «

Article on Silver Brazing

In an article entitled "Low-Temperature Silver Brazing Used in Making Chemical Mortar Shell," Colonel H. R. Lebkicher of the Chemical Warfare Service discusses the conditions and proper treatment for brazing with silver alloys. Special attention is, of course, given to the 4.2 chemical mortar shell, which has a base and an adapter to be brazed to the body with silver-brazing alloy. Chemical cleaning and fluxing, the properties and working temperatures of silver-brazing alloys and the operating methods involved in brazing, are discussed in detail. A copy of this article may be obtained from **Handy & Harman,** 82 Fulton St., New York City 7.

» «

Gas-Welding Catalog

An enlarged and revised edition of the Nageldinger catalog mentioned in THE WELDING ENGINEER for June, 19[illegible] has just been announced. The catalog is now a 36-page, letterhead-size booklet covering a complete line of apparatus for the regulation and control of compressed gases. Among the products listed are cylinder valves, cylinder manifolds, needle-valve controls, welding and cutting equipment, pressure-regulating valves and regulators, safety valves and other compressed gas apparatus for oxygen, acetylene, hydrogen, carbon dioxide, helium, ethylene, propane, butane, city gas and compressed air. Joseph **Nageldinger & Son, Inc.,** 409 East 9[illegible] St., New York City 28.

» «

Clamps and Fittings

Punch-Lok Catalog P-1, an eight-page, letterhead-size booklet on clamps and fittings, contains technical data to aid in the application and proper use of the company's "Loking" tool for connecting male and female fittings, nipples, menders or pipe to hose. A method of splicing welding cable is also illustrated. **Punch-Lok Co.,** 321 North Justine St., Chicago 7.

» «

Steel Fabrication Bulletin

A four-page, letterhead-size bulletin has been issued by **Marine Fabricators Co.,** Perth Amboy, N. J., to describe and illustrate the equipment and services it has available for all types of steel fabrication. The operations covered are welding, precision shape cutting, plate rolling, shearing, machining and bending heavy steel plate.

» «

Hydraulic Pump Bulletin

A four-page, letterhead-size folder, Bulletin 138, has been published by **Lyon-Raymond Corp.,** 1981 Madison St., Greene, N. Y., to give information on foot-operated and hand-operated hydraulic pumps. The company has pioneered in this field and is now prepared to give an engineering service in the selection and application of standard and special high-pressure hydraulic pumps.

» «

Chain-Hoist Bulletin

A 12-page, letterhead-size bulletin entitled "The Chain Hoist of Tomorrow Today & Yesterday" describes and illustrates the Chester line of chain hoists and trolleys. **Chester Mfg. Co.,** Lisbon, O.

Little Welds that *Save* Big Castings

WHETHER defects in gray iron castings are discovered on the foundry floor or in the machine shop after a lot of machining has been done, PHILLIPS "600" Electrode is a complete cure. It fills holes like these with a dense deposit, of the color of cast iron, fully machinable through the line of fusion.

PHILLIPS "600" has been in use for years in hundreds of foundries and machine shops, salvaging all kinds of gray iron castings regardless of size—motor frames—traps—pump parts—furnace sections—engine blocks.

Eliminate the expensive preheating that is necessary when welding these castings with gas—Use PHILLIPS "600" and the fast, low cost electric arc process—Your salvage operations will cost only a trifle compared to the savings you will make—savings that will be welcome in your post war operations.

This new manual is a complete guide to the selection of materials and procedures for arc welding cast iron. Send for your copy TODAY.

C. E. Phillips & Company carry in stock 145 different kinds (not sizes) of welding rods and electrodes. If a rod for your special problem is available, we have it. Catalog and price list on request.

Distributors in all principal cities.

C. E. PHILLIPS & COMPANY

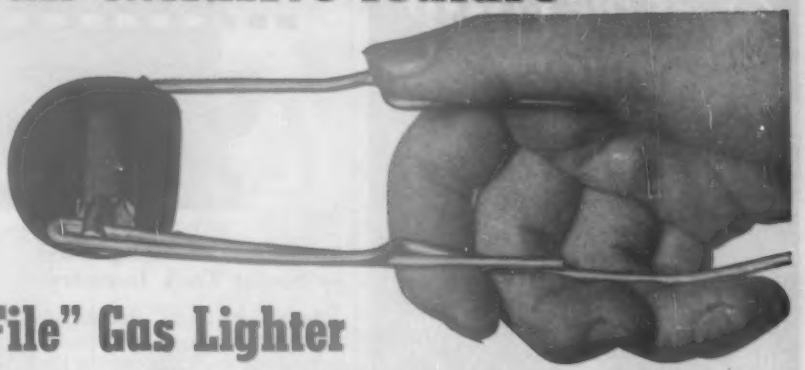
2750 Poplar Street, Detroit 8, Michigan
332 So. Jefferson St., Chicago 6, Illinois

MANUFACTURERS AND DISTRIBUTORS OF WELDING ELECTRODES AND SPECIALTIES

Locking "Slip-on" Renewal

an exclusive feature

The patented cartridge holding the spark metal locks exactly in correct position, permitting instant replacement. Get acquainted with the many other superior, exclusive features of Improved "Round File."



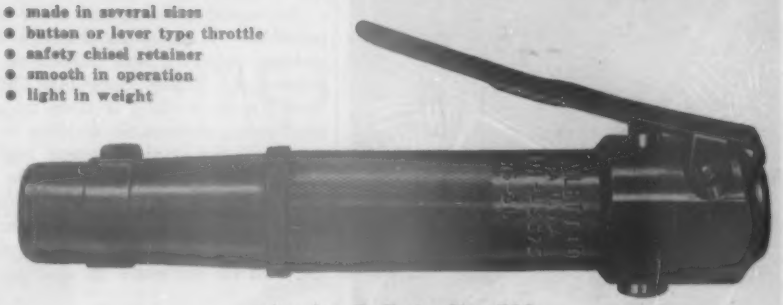
The Improved "Round File" Gas Lighter

SAFETY GAS LIGHTER CO. (Est. 1901) LYNN, MASSACHUSETTS

DALLETT Pneumatic Weld-Flux Scaling Hammers

Especially designed for roughing, peening, removing flux and excess metal resulting from welding operations.

- made in several sizes
- button or lever type throttle
- safety chisel retainer
- smooth in operation
- light in weight



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MASCHER AT LIPPINCOTT STREET
PHILADELPHIA 33, PENNSYLVANIA
Distributed in Canada by G. D. PETERS & CO. OF CANADA, Ltd.
1021 New Birks Bldg., Montreal

PNEUMATIC AND HAND CHISELS
"DALBO" AIR HOSE COUPLINGS
"DALLETT" PNEUMATIC SAFETY RETAINER SHANK CHISELS
"DALWELD" DETACHABLE WELDING CABLE CONNECTORS

write for Bulletin No. 500

W-AL-CO RODS for Welding of ALUMINUM

ARC WELDING ELECTRODES
(Flux-Coated)

Type E-43—5% Silicon-Drawn Aluminum

Type E-2S—Pure Drawn Aluminum

*Types E-142, E-195, E-355 and E-356—Aluminum Alloy for welding CAST ALUMINUM

Send for descriptive circular.

GAS WELDING RODS
(Flux-Coated)

Type G-43—5% Silicon-Drawn Aluminum

Type G-2S—Pure Drawn Aluminum

*Types G-142, G-195, G-355 and G-356—Aluminum Alloy for welding CAST ALUMINUM

*Available in 1/8" size only

Assure dense, ductile, strong welds. Ease of Control; Free-Flowing Characteristics; Increased Welding Speeds.

WELDING ALLOYS MANUFACTURING CO. 744 Broad St., NEWARK 2, N. J.

WELD-A-CAST Flux

The old brand is still the best

No. 1. For Welding with Cast Iron Rod.

No. 3. For Brazing and Bronze Welding.

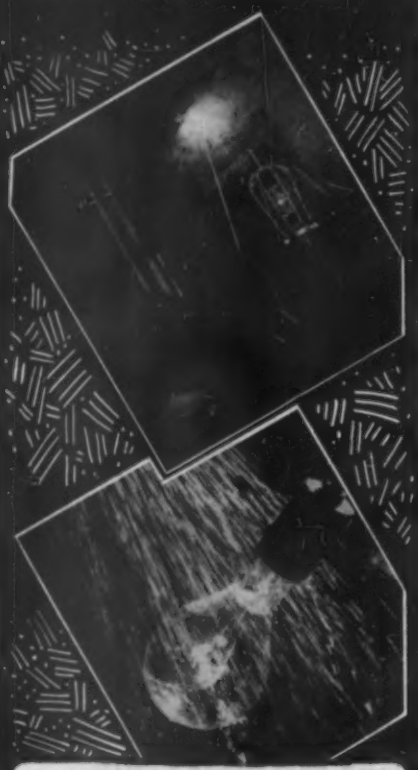
No. 4. For Welding Cast Aluminum.

Ask Your Dealer—or write

WELD-A-CAST
OXY-ACETYLENE WELDING FLUXES

CORTLAND WELDING COMPOUND CO.
Cortland, N. Y.

Beat the LAMP SHORTAGE with Thermacoted LAMPS



THERMACOTED LAMPS
defy breakage
from weld spatter, rain,

moisture condensation or other causes of breakage by thermal shock. Top photo shows Thermacoted lamp hung directly under welding arc with no resulting breakage. Lower photo shows Thermacoted 500 watt lamp under shower of water (note both lamps are lit).

Millions of lamps saved in shipyards and other industries

Ask your nearest lamp dealer

THERMACOTE CO.
122 Arlington Street, Newark 2, N. J.
612 No. Michigan Ave. 11, Chicago, Ill.
1101 McLaughlin Blvd. Portland 2, Ore.
420 South San Pedro Street
Los Angeles 13, California

News of the Industry

Automatic Welding Used by Soviet Tank Industry

Soviet engineers, technicians, foremen and workers are conststanly improving methods of work, shortening the production cycle and speeding up the assembly of tanks. According to information from Moscow cabled to *The Engineers' Digest*, New York City, the average time required for the production of a tank was reduced by 60% at one big tank works and by 66% at two other works.

Automatic welding has made such feats possible. Academician Paton's automatic welding conveyor was introduced only two years ago. Today more than 30% of all Soviet tank welding is done by automatic machinery. Automatic welding is not only employed for straight seams but also for rounds and other shapes. While effecting a four to five-fold increase in labor productivity, the process has reduced the expenditure of electric power by more than 30% and that of electrodes by nearly one third.

» «

New WPB Restrictions on Resistance Welders

Restrictions on the placement of unrated or non-authorized orders for certain types of manufacturing machinery are prescribed by the War Production Board in an amendment to Priorities Regulation 24. The machinery and equipment affected are covered by orders on List A of PR-24, which includes resistance-welding equipment.

An unrated or non-authorized order must carry the standard certification required by PR-7 together with a statement that the order is placed pursuant to PR-24. The ultimate user of the machinery or equipment must place the order, and a delivery date earlier than actually required may not be specified.

The distributor or dealer may fill an unrated or non-authorized order by placing it with his supplier or delivering the material from inventory. In the latter case, he may replenish inventories of items already delivered on orders placed under PR-24. However, he may not increase inventories on hand in this manner, as was the previous practice.

Under the previous provisions of PR-24, dealers could place unrated or non-authorized orders for machinery and equipment merely to build up a stock. This is no longer permitted, WPB asserts.

» «

WLB Loosens Grip on Wage Increases

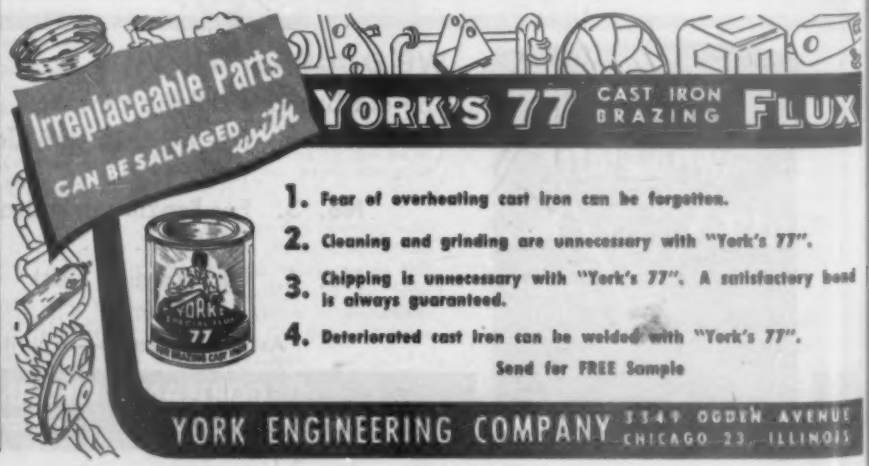
Voluntary wage and salary increases which do not bring rates above 50c an hour may now be put into effect by employers without the necessity of obtaining the approval of the National War Labor Board. Hitherto, such adjustments could be made without WLB approval only up to 40 cents an hour.

No basic change of policy is involved since the WLB had been regularly approving voluntary wage adjustments between 40 and 50 cents an hour. The revised order (General Order No. 30) specifies that increases between 40 and 50 cents an hour made without approval may not furnish a basis to increase price ceilings.

» «

Titan's New Mill Now in Production

The new brass rod mill of the Titan Metal Mfg. Co., Bellefonte, Pa., is now in operation, according to an announcement by W. W. Seig, general manager. The mill will double the former production of brass rods. It was built in record time and financed by Defense Plant Corp.


Irreplaceable Parts
CAN BE SALVAGED with
YORK'S 77
CAST IRON BRAZING
FLUX
1. Fear of overheating cast iron can be forgotten.
2. Cleaning and grinding are unnecessary with "York's 77".
3. Chipping is unnecessary with "York's 77". A satisfactory bond is always guaranteed.
4. Deteriorated cast iron can be welded with "York's 77".
Send for FREE Sample
YORK ENGINEERING COMPANY
3349 OGDEN AVENUE
CHICAGO 23, ILLINOIS

SPOT · BUTT · ARC
WELDERS

WRITE FOR CATALOG

We manufacture a complete line of resistance spot welders from ¼ to 300 KVA for all types of welding. There is an EISLER WELDER for every purpose.

TRANSFORMERS OF ALL TYPES

WE INVITE CONTRACT SPOT WELDING IN LARGE OR SMALL QUANTITIES.

CHAS. EISLER
EISLER ENGINEERING CO.
749-SO 13th ST. Near AVON AVE. NEWARK N. J.

Fuse-Weld
Cast
Welding Rods

The Standard of
QUALITY
THROUGHOUT THE WORLD

Cast Aluminum Welding Rods
of Standard Analysis

Plain and alloyed Gray Iron
Welding Rods and Electrodes

THE CHICAGO HARDWARE FOUNDRY CO.
Dependable Since 1897
145 ENGINEERING BUILDING
NORTH CHICAGO, ILLINOIS

GIVE THEM
THE *Best*
COAT YOUR RODS WITH
Titanox

TITANOX-coated welding rods

- ✔ help to stabilize the arc
- ✔ increase speed of welding
- ✔ give more protective slag
- ✔ make for higher strength and ductility

TITANOX-A (titanium dioxide) is recommended for welding rod coatings because of its uniformity of chemical composition and fine working properties.

We will gladly supply samples and technical information regarding your individual requirements.

TITANIUM PIGMENT CORPORATION
SOLE SALES AGENT
111 Broadway, New York 6, N. Y.
104 South Michigan Ave., Chicago 3, Ill.
350 Townsend St., San Francisco 7, Cal.
2472 Enterprise St., Los Angeles 21, Cal.

TITANOX
REG. U.S. PAT. OFF.

Pressure welding of pipe lines will be taught at a special school to be held at Houston, Tex. The equipment used in the training program is identical with that actually used in the field.

Linde Will Conduct School on Pipe Pressure Welding

A training course for the purpose of giving detailed instructions in the proper procedure to be used in the oxy-acetylene pressure welding of overland pipe lines will be conducted by The Linde Air Products Co. beginning January 15 at the warehouse and plant of the Pressure Weld Co., Houston, Tex. The school will be held under the direction of Linde service operator H. A. Yost, assisted by members of the Pressure Weld Co. field force.

A welding clamp of the type used in the field (see accompanying picture), together with necessary auxiliary equipment, will be used to train the men under actual field conditions. Each trainee should bring work clothes with him, the company's announcement states, because he will actually operate the pressure-welding equipment. The average training period is about two days.

More complete information on the pressure-welding school may be obtained by addressing the Houston office of The Linde Air Products Co., 6119 Harrisburg Blvd., Houston 11, Tex.

» «

Lincoln Electric Pays a Record Worker Bonus

Almost three million dollars in year-end incentive payments was distributed to employees of The Lincoln Electric Co., Cleveland, representing the largest bonus per capita since the company's incentive policy went into effect in 1934. Checks were given to approximately 1,100 workers, who received amounts ranging from $150 for new employees up to $40,000 for each of four persons whose contribution to the business was valued as "outstanding."

Lincoln employees have matched the normal output of three times their number in industry, President J. F. Lincoln announced. Factory workers received 90% of the bonus money, and $2,500 was the average payment above base wages.

» «

Weldors' Garment Makers Consolidate

Fred Jessar, Philadelphia, announces the merger of his weldors' clothing business with the Welders Safety Garment Company and Welders Leather Supplies, Philadelphia. The consolidated business will be under the active management of Mr. Jessar. Its new name and address are: Aljay Mfg. Co., 634 Race St., Philadelphia.

» «

New Allis-Chalmers Film on Gas Turbine

The gas turbine, newest source of prime power and hailed as "the power plant of the future," makes its motion picture debut in a 16 mm film entitled "Tornado in a Box," released by the Allis-Chalmers Mfg. Co., Milwaukee 1. This is the third of a series of educational films released by Allis-Chalmers, the first being "The Magic of Steam," a story about the steam turbine, and the second "The Surface Condenser." These films are loaned free to any industrial or engineering group interested in showing them.

Ingenious New

Technical Methods

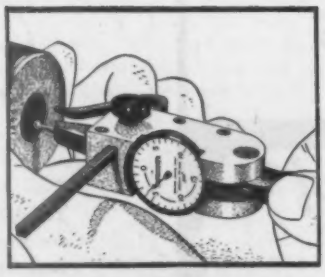
Presented in the hope that they will prove interesting and useful to you.

New Internal Gage Avoids Over Cutting... Saves Wasted Man Hours

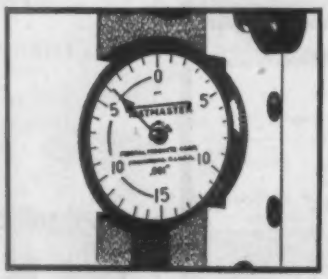
At last a gage that takes the guess work out of checking internal diameters either machine bored, or close ground and lapped. It is called the Keene Internal Gage and is the first accurate method for fast correct checking of internal splines and gears on both minimum and root diameters. The gage is ideal for machining and inspection work, and proves its value in increased production. It can be used with either a master, or micrometers.

This time saving development is constructed of aluminum, is six inches long and weighs only five ounces. Available in models designed to read in thousandths (.001) or in tenths (.0001).

When your gage has been checked the thousandths left to bore, the actual job of machining may become tedious. It is then when Wrigley's Spearmint Gum helps keep you alert and watchful. Chewing gum seems to assist you over the dull spots in the day's work. And Wrigley's Spearmint will aid you in your peacetime job by helping to keep you wide awake and efficient during that part of your work that may seem unimportant, but which actually means perfection to the completed product.



Determining correct setting for gage.



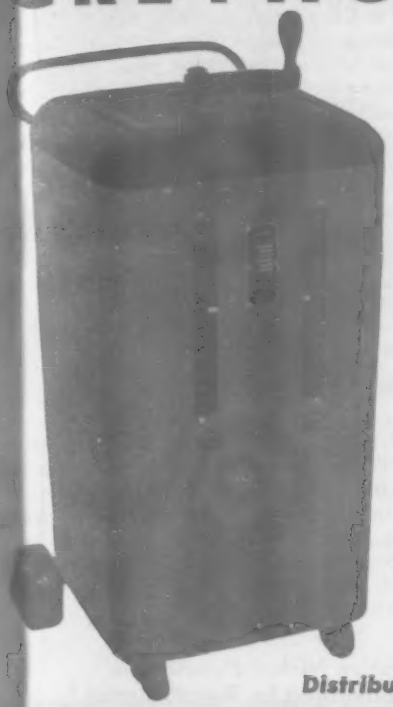
Closeup of dial showing simplicity and fast visibility.

You can get complete information from Keene Electrical Machinery Co., 542 W. Washington Blvd., Chicago 6, Illinois.

2-51

The NEW, IMPROVED Variable-Core type

GREYHOUND



A. C. Arc Welders Provide LOWER OPERATING COSTS for HEAVY DUTY PRODUCTION

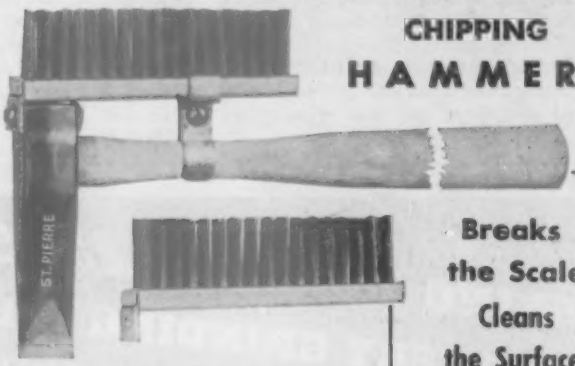
Detailed information and prices sent on request

Distributors Wanted

GREYHOUND A. C. ARC WELDER CORP.
Manufacturers
520-28 Morgan Ave., Brooklyn, N. Y.

ABUSE MEANS NOTHING TO ST. PIERRE

CHIPPING HAMMERS



Here's a man-sized brush in the right position for easy use after chipping scale from welded surface. Hammer-Chisel made of highest quality tool steel. Entire tool is well-balanced. For economy, for durability use ST. PIERRE Hammers.

Breaks the Scale Cleans the Surface in One Operation

Order Today From Your Jobber or Direct

ST. PIERRE Chain Corporation
WORCESTER DROP FORGINGS MASSACHUSETTS

The RIGHT FLUX for the JOB

No. 2 FLUXINE for brazing and bronze welding—copper, copper alloys, malleable iron and steel.

No. 6 FLUXINE . . . non-glaring . . . for bronze bonding—cast and gray iron with bronze and nickel alloy rods.

No. 7 FLUXINE for welding all types of aluminum.

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No. 41 FLUXINE used with high-melting silver solders on copper and its alloys and on steel.

No. 42 FLUXINE used with Westinghouse Phos-Copper rods and low-melting silver solders on copper and its alloys.

No. 43 FLUXINE . . . non-glaring . . . used whenever low-melting silver solders are specified. No injurious fumes.

Wherever a flux is required "FLUXINE" flux will do it better and more economically. Write us today for sample. Address Dept. G.

Better jobbers everywhere carry the "FLUXINE" line.

KREMBS & COMPANY
Est. 1875
West Ohio Street, Chicago 10, Ill.

FLUXINE
TRADE MARK REGISTERED U. S. PAT. OFF.

Reach for

DUCTONE

(E6011) AC (E6013)

WELDING RODS

Available again, after three years of war service. DUCTONE AC rods are designed and manufactured especially for AC welding. It is the best rod for all position and general purpose welding. DUCTONE AC rods have deep penetration, are good on dirty materials and operate on exceptionally low current. Small sizes are especially good for thin sheet metal. Excellent for vertical and overhead welding on DC positive polarity. Extruded in all sizes from 1/16" to 1/4". See your dealer.

Territories Available for Distributors

Chicago Steel and Wire Co.
103rd St. and Torrence Ave.
Chicago 17, Illinois

Reach for DUCTONE AC Welding Rods

Indiana Distributor Holds a Quarter Century Jubilee

To celebrate its twenty-fifth anniversary, the Wayne Welding Supply Co., Inc., 513 East Wayne St., Fort Wayne, Ind., last month staged its own welding exhibition. Nine manufacturers of welding equipment participated with exhibits, demonstrations, films, slides and lectures.

Approximately 350 engineers, foremen, purchasing agents and welding mechanics attended the activities, conducted over a two-day period from 1 p.m. until late at night. The exhibitors provided backgrounds and equipment for a variety of demonstrations and were kept busy answering questions and explaining procedures.

The participating manufacturers were: Air Reduction Sales Co., American Brass Co., Ampco Metal, Inc., Jackson Products, Handy & Harman, C. E. Phillips & Co., Sight Feed Generator Co., The Linde Air Products Co., and Westinghouse Electric & Mfg. Co.

The Wayne Welding Co. was launched in December, 1919, by James M. McClure and incorporated in 1930 with Mr. McClure as president. The company operates its own welding department and in addition acts as a distributor for welding machines, apparatus, gases and other supplies in northeastern Indiana and adjacent sections of Ohio and Michigan. Three salesmen are employed.

BRING Production-Line Speed
TO EVERY GRINDING JOB with
SKILSAW PORTABLE GRINDERS!
Tackle the toughest bead grinding jobs with SKILSAW PORTABLE GRINDERS and you get a smoother finish faster! That's the experience of busy welding shops where they use SKILSAW PORTABLE GRINDERS to put all grinding on a production line basis.
These grinders go right to the work, save material handling, save time, money, manpower. And they operate for less because they're built with every quality feature to assure trouble-free operation longer. Ask your distributor today for a demonstration!
SKILSAW, INC.
5033-43 Elston Ave., Chicago 30, Ill.
Sales and Factory Branches in All Principal Cities
SKILSAW PORTABLE ELECTRIC TOOLS
MAKE AMERICA'S HANDS MORE PRODUCTIVE

PLANNING RETOOLING AFTER-THE-WAR?

Let SKILTOOL Field Engineers help you now to plan "tooling-up" for more efficient and economical peacetime production with SKILSAW'S new postwar tools.

Westinghouse Develops Spotlight for Welding

Before he strikes his arc, an arc weldor is as blind as the traditional bat. He cannot distinguish objects under normal illumination through the tinted glass window of his mask. Although the brilliant arc provides ample light after welding actually begins, to strike the arc in the proper place is extremely difficult.

A new spotlight developed at the Westinghouse research laboratories casts on the work area a light of 10,000 foot-candles—twice as bright as the brightest sunlight on a seashore in summertime. This takes out the guesswork of striking the arc in the proper place, for it enables the weldor to see the spot to be welded clearly through the dark-glass window of his helmet.

This bright beam of light is furthermore produced without creating much heat—important to a weldor working in a small booth in the summertime. It requires the expenditure of only 32 watts, less than one third the energy consumed by a good reading lamp at home. Still a laboratory development, however, the new spotlight is not yet commercially available.

» «

Entire Nickel Production Consumed in War Material

"Demand for nickel continued strong during 1944 with virtually the entire production consumed in essential war material," Robert C. Stanley, chairman and president of The International Nickel Co. of Canada, Ltd., declared in a recent year-end statement. "The nickel requirements of the armed services, war production and essential services have continued at a high rate and have absorbed virtually the entire nickel supply," he said. "Therefore, the release of any appreciable quantities of the metal for civilian purposes must await cutbacks from the present rate of war orders."

President Stanley said that present production facilities would insure an adequate supply of all nickel requirements expected after war demands are over.

» «

New Contracts Awarded to Build 45,000 Jeeps

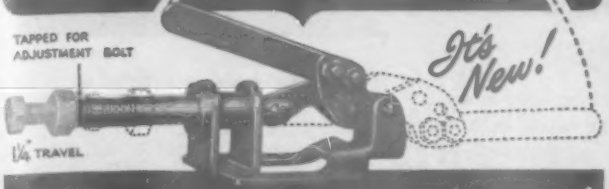
Additional orders given by Ford Motor Co. and Willys-Overland Corp. to the American Central Mfg. Corp., Connersville, Ind., will add another 45,000 jeep bodies to the existing contracts under which more than 400,000 bodies have already been built and are building. Under terms of the expanded contracts, American Central will continue at maximum production on this equipment through next summer.

» «

Open a New Shop at Visalia, Calif.

Van S. Hughes and Roy E. Wyatts have opened a new welding shop at Visalia, Calif., and will do general farm welding and repair work. After the war they intend to go into the manufacture of butane tanks, underground tanks, cattle tanks and similar structures.

DE-STA-CO Model 605



"PUSH AND PULL LOCK" CLAMP

Especially well suited for locating and indexing, fills a definite need on many jigs and fixtures. Work end (plunger rod) is tapped to receive standard bolt, which provides quick adjustment to suit the job at hand. Quickly converted from "push" to "pull" action or vice versa.

Bulletin No. 43 details this and many other labor saving De-Sta-Co toggle action clamps. Send for your copy.

DETROIT STAMPING CO.
Established Over 25 Years
372 Midland Ave • Detroit 3, Mich.

START THE ARC *Automatically*

NO PECKING or SCRATCHING with the

MISSING LINK AUTOMATIC ARC HY CYCLE UNIT $59.50 COMPLETE

★ It's easy to start the arc with this new advancement in electric welding . . . the "MISSING LINK." Arc starts automatically without the annoying, tiresome, obsolete method of "pecking" and "scratching" the work to get going. Attach "Missing Link" to any arc welder, AC or DC. Use any type of welding rod and get faster, better welding with greatly reduced operator fatigue. What's more, beginners can become experts almost overnite with the aid of this unit. Makes work far easier for experienced welders.

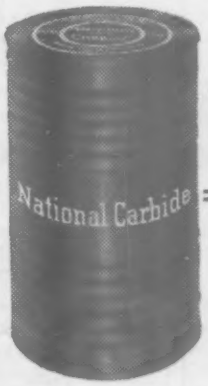
Multiply your man-hours and get many other cost-reducing advantages, by equipping with the "Missing Link." Act now! Get complete details on this low-cost, time-saving unit.

See Your Jobber or Write Direct

Mid-States EQUIPMENT CO.
2431 SOUTH MICHIGAN AVENUE, CHICAGO 16, ILLINOIS

National Carbide

• EFFICIENT
ECONOMICAL
DEPENDABLE •



For Welding and Cutting *Specify*

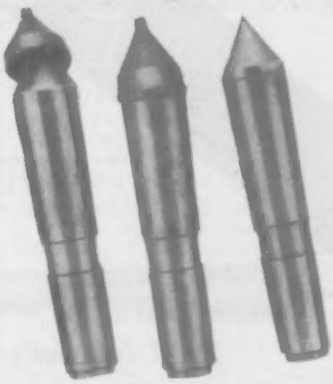
NATIONAL CARBIDE IN THE RED DRUM

•

NATIONAL CARBIDE CORPORATION
60 E. 42nd St., New York 17, N. Y.

YOUR WORN TOOL STEEL CENTERS *Can be Salvaged by using*

COLMONOY



TIPPING SERVICE

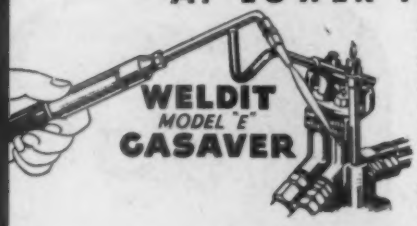
● New tip castings of Colmonoy No. 6 can now be applied to your centers by using Silver Solder or a low temperature brazing alloy. Will outlast and outwear new, untipped centers.

We will apply for you, or furnish tips only. Moderate prices. Write for Bulletin CT-1 for complete information.

WALL-COLMONOY CORP.
720 Fisher Bldg., Detroit 2, Mich.

Safe Welding

AT LOWER PRODUCTION COSTS



The Weldit Gasaver shuts off the welding flame when not in use. . . . Conserves essential materials by cutting oxygen and acetylene consumption as much as *fifty* per cent. Prevents injury to workmen—or sudden fires—from dangerous idle torch flames. . . . Adjustment remains unaltered between welds.

When the Weldit Gasaver has been installed, you simply hang idle torch on the handy lever rod. Weight of torch pulls rod down, thus automatically shutting off supply lines. Relight instantly by passing torch over Gasaver pilot light. No bother. . . . No time lost. . . . *No readjusting required.* . . . Price $10.00 at Detroit. Order today.

Better Soldering, Annealing and Heating Jobs

The Weldit Model CW Blowpipe is in daily use by many foremost industrial plants. . . . Built in accordance with the recommendations of leading fabricators of sheet metal products. . . . Operates on either natural gas, manufactured gas, or other low temperature fuel gas and compressed air. Stands up under rough shop use. . . . Send for literature.

WELDIT ACETYLENE CO.
628 BAGLEY AVENUE · DETROIT 26, MICH.

"EITHEREND" CABLE CONNECTOR

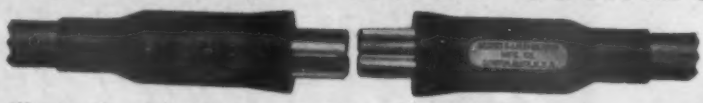
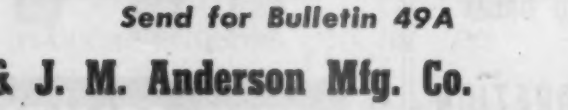


Illustration shows connector apart with sleeves

BOTH ENDS EXACTLY ALIKE
Neither male nor female

Center illustration shows connector protected by the insulating sleeves pushed together and locked, ready for work: butt rubber sleeves make waterproof joint.

Lower illustration shows solderless type of connector without rubber sleeves. Made in sizes from 4/0 to #10 soldered and from 4/0 to #6 solderless.



Send for Bulletin 49A

Albert & J. M. Anderson Mfg. Co.
289-305 A St. • Boston, Mass.
NEW YORK CHICAGO PHILADELPHIA LONDON

ABOUT PEOPLE

E. Peerce Lake, a veteran of 18 years with General Motors, has been appointed vice-president and general manager of the Warren City Mfg. subsidiary of Graham-Paige Motors Corp. He was vice-president and general manager of the Columbia Machinery and Engineering Corp. before joining the Graham-Paige organization.

» «

Andrew Kaul III has been elected president of the Speer Carbon Co., the International Graphite and Electrode Corp. and the Speer Resistor Corp, with offices at St. Marys, Pa. He assumed his new duties on Dec. 1.

» «

Edward G. Budd, founder-president of the Edward G. Budd Mfg. Co., Philadelphia, was honored by the award of the ASME Medal at the recent annual dinner of the American Society of Mechanical Engineers. The award was presented "because of his oustanding engineering achievements." The Budd company pioneered in the field of steel automobile bodies and also developed the "Shotweld" process of fabricating stainless steel, a process which has made possible the use of this alloy for the building of streamlined railroad cars and truck trailers.

» «

Paul H. Setzler has joined the engineering staff of the United Welding Co. Middletown, O., as consulting engineer on welding problems.

» «

Russ O. Laub and **Hans C. Andersen** have been promoted to the positions of superintendent of cost planning and plant industrial engineer respectively of the Gary sheet and tin mill of Carnegie-Illinois Steel Corp. Mr. Laub, who served as plant industrial engineer for the last three years, succeeds **C. E. Moore**, recently transferred to Pittsburgh. Mr. Andersen succeeds Mr. Laub as plant industrial engineer.

» «

Theodore H. Sanderson has been appointed division superintendent of the armor plate division at Gary Works, Carnegie-Illinois Steel Corp., succeeding the late **E. N. Yost.** Mr. Sanderson was formerly assistant superintendent of quality control of the armor plate plant.

» «

Harold Martin has been appointed assistant manager of New England sales of the American Steel & Wire Co. He will continue to be located in the company's Boston sales office, where he has been manager of merchant product sales since March, 1942.

The Treasury Department acknowledges with appreciation the publication of this message by

THE WELDING ENGINEER

This is an official U. S. Treasury advertisement prepared under the auspices of Treasury Department and War Advertising Council.

We can see with the naked eye that the Payroll Savings Plan provides the most stable method of war financing! Under the X-ray of sound economics other important advantages appear.

A check on inflation, the Payroll Savings Plan helps industry to build the economic stability on which future profits depend. Billions, invested through this greatest of all savings plans, represent a "high level" market for postwar products. Putting over this plan *together* also establishes a firmer, friendlier relationship between management and labor.

To working America the Payroll Savings Plan offers many opportunities. Through this systematic "investment in victory," homes, education for their children and nest eggs for their old age are within the reach of millions.

These benefits to management and labor are national benefits. Instilling the thrift principle in the mind of the working men and women, the Payroll Savings Plan assures their future security—and is a definite contribution to the prosperity of postwar America!

P&H WELDING POSITIONERS

WELD FASTER, EASIER, AT LOWER COST!

Model WP-2—2500 lbs. Capacity

There are more big time-and-money-saving advantages in this new P&H WP-2 Welding Positioner than you would believe possible — at such surprisingly low cost.

The WP-2 is the most versatile positioner in its class — easiest to operate. Of all-welded steel construction with large table area and hydraulic power tilting — it is available with manual, handwheel or power turning. Has positive table locking device — telescopic elevation.

Write for Free Bulletin

. . . of facts and pictures giving complete story! Start now to save time, costs by positioning your work. It shows you how! Ask for Bulletin P2-1.

General *Offices:* 4513 West National Ave., Milwaukee 14, Wis.

HARNISCHFEGER CORPORATION

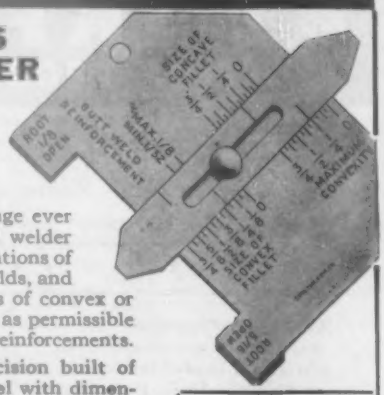
ARC WELDERS • EXCAVATORS • ELECTRIC CRANES P&H MOTORS • HOISTS • WELDING ELECTRODES

Canadian *Distribution:* The Canadian Fairbanks-Morse Co., Ltd.

PALMGREN

WELDER'S MICROMETER

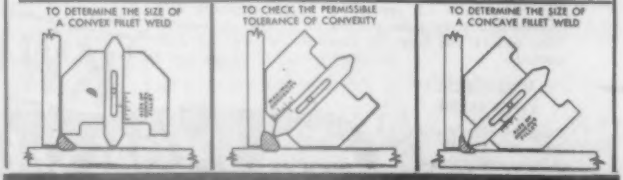
For Accurate Calibration of BUTT & FILLET TYPE WELDS



The finest welding gage ever developed. Enables a welder to meet exact specifications of butt and fillet type welds, and accurately check sizes of convex or concave fillets as well as permissible tolerance of butt weld reinforcements.

Instrument is precision built of chromium plated steel with dimensional readings clearly indicated. Made pocket size 2½" x 3" very handy and easy to operate. Eliminates rejections. Saves time and electrodes. **Price $3**

Write for details and Welding Symbols Chart

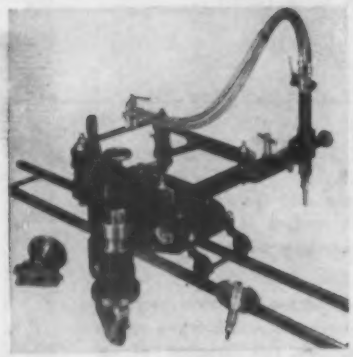

TO DETERMINE THE SIZE OF A CONVEX FILLET WELD
TO CHECK THE PERMISSIBLE TOLERANCE OF CONVEXITY
TO DETERMINE THE SIZE OF A CONCAVE FILLET WELD

CHICAGO TOOL AND ENGINEERING CO.

Manufacturers of PALMGREN PRODUCTS for Over 25 Years

8407 SOUTH CHICAGO AVE. CHICAGO 17, ILLINOIS

NOW COMPLETE PORTABLE SHAPE CUTTING FACILITIES



To the popular uses of portable cutting machines there has now been added the luxurious control-ease and accurate shape cutting reproduction of high priced shape cutting machines. Every Steel Fabricating Shop needs the new popular priced GASO V-10 with automatic shape cutting attachment. Tracing irregular shapes and circle cutting are made easy and accurate on the new GASO V-10 with automatic shape cutting attachment. Optional attachment allows spindle head operation and template head operation, the latter enabling large quantities of duplicate parts to be automatically and accurately flame cut.

GASO V-10 CUTTING MACHINE WITH TRACING HEAD MOUNTED FOR OPERATION. The template is shown on the left and the spindle head at the right.

GASO V-10

TWO MACHINES IN ONE

All portable, the new, popular priced GASO V-10 with automatic shape cutting attachment performs the functions of two machines in one: Automatic straight line cutter and automatic shape cutter. The GASO V-10 with automatic shape cutting attachment is: motor driven; fully automatic on all shapes; adjustable 3"—60" per minute; designed for instant start and stop; and equipped with unitary shut-off valve. The GASO V-10 is equipped with 5 foot track—cutting table optional.

Shape Cutting Attachment.

Some Distributor Territories Still Available.
Write today for new bulletin giving full information.

GASO EQUIPMENT COMPANY

3253 North Kedzie Avenue **Chicago 18, Illinois**

SUPER-WETTING KWIKFLUX SPEEDS PRODUCTION

Fast Flowing . . . No Lumping or Pitting of Solder

KWIKFLUX accomplishes 25% to 50% higher wetting action than the fluxes now on the market, and has almost 100% higher penetration in deep joints. It works perfectly with direct gas flame, hydrogen, acetylene—muffle (direct or indirect) and induction heating.

KWIKFLUX is used for brazing, hard soldering and welding of Stainless Steel, Iron, Copper, Brass, Bronze, Platinum, Gold, Silver, Monel Metal, Nickel, German Silver and other ferrous or non-ferrous metals and alloys. It will not blacken brass or copper, and is suited to either automatic or manual operations. Fast, efficient action assures improved quality and finish.

MEETS GOVERNMENT AND ALL RIGID STANDARDS AND SPECIFICATIONS

For more than 12 years, our tested research improvements have been passed on to our customers. This service has been in operation during the war period.

WRITE FOR LITERATURE

Data sheets describing KWIKFLUX in detail—advantages, properties, characteristics and price—will be sent promptly on request. There is no obligation.

OUR NEW PRICE SCHEDULE EFFECTIVE JAN. 1ST, 1945 PLACES KWIKFLUX ON AN ALL-INCLUSIVE COMPETITIVE BASIS.

Features:

(1) Perfect with both Low and High Melting Point Hard Solders.

(2) Excess Flux washes off clear in hot water—saves cleaning and finishing time.

(3) Does not lump or pit solder. Forms smooth film easily washed off, leaving surface beneath bright and shiny.

(4) Faster Fluxing Actions—saves time, gas and electricity.

(5) Fumes are fixed because KWIKFLUX is neutral. Increases production efficiency.

SEND FOR FREE TRIAL JAR

KWIK FLUX

SPEC SPECIAL CHEMICALS CO.

30-36 IRVING PLACE, NEW YORK 3, N. Y.

John R. Bangs, general manager of industrial and personnel relations of the Edward G. Budd Mfg. Co., Philadelphia, is the editor of the new 1,700-page "Production Handbook" just published by the Ronald Press Co. He undertook to complete work on the volume, which had been halted by the death of the first editor, Dr. L. P. Alford, chairman of the department of administrative engineering of New York University. A board of more than 90 contributing and consulting editors assisted Mr. Bangs in the compilation of this mammoth work, which gives authoritative coverage of such subjects as plant personnel and industrial relations, plant organization, production planning and control, purchasing, inspection, motion study, job estimating, machinery and plant layout.

» «

Edward R. Fish has retired from The Hartford Steam Boiler Inspection & Insurance Co., with whom he had been connected since 1930. Mr. Fish has also withdrawn from the ASME Boiler Code Committee, of which he had been a member since 1918 and chairman for the past three years.

» «

Willis T. Cramer has been named assistant director of research of the American Steel & Wire Co., Cleveland, succeeding **Raleigh H. Barnes,** deceased. Mr. Cramer was formerly works metallurgist at the company's Cuyahoga Works.

» «

Lyman H. Bellows, formerly with the Stanley Electrical Tool Division, New Britain, Conn., has been appointed sales manager of Sheldon Machine Co., Inc., Chicago manufacturer of lathes and milling machines.

» «

Frank O. Zimmerman, formerly with the Westinghouse Electric Elevator Co., has been made assistant manager of the Chicago sales branch of Federal Telephone and Radio Corp.

» «

Harvey D. C. Dunn, formerly chief engineer at the Dallas plant of the Link-Belt Co., has been appointed to the newly created post of chief engineer of the Link-Belt Minneapolis plant (acquired last year from Link-Belt Supply Co.). **Maurice J. Erisman,** a member of the engineering department at the company's Chicago plant, has been transferred to Dallas to take the place of Mr. Dunn.

» «

George Fay, formerly treasurer of the Hydril Corp., Los Angeles, has resigned to become comptroller of the Rheem Mfg. Co.

» «

L. Boyd Hatch, executive vice-president and a director of Atlas Corp., N. Y., has been elected a member of the board of directors and the executive committee of Graham-Paige Motors Corp.

WELDON ROBERTS

Brightboy

GRIND TO BUFF — ONE OPERATION
Saves Time and Improves Work With Simultaneous

- BURRING
- FINISHING
- POLISHING

BRIGHTBOY INDUSTRIAL DIVISION
Weldon Roberts Rubber Co.
Newark 7, New Jersey

Speed the Victory with

SHAWINIGAN CARBIDE

SHAWINIGAN PRODUCTS CORPORATION
EMPIRE STATE BUILDING
NEW YORK 1, N.Y.

METAL BOND
METAL BOND MFG. CO.
ST. LOUIS U.S.A.

METAL BOND

Welding and Brazing Fluxes are Quality Products

SEND CARD FOR OUR A-4 CATALOG

All Metal Bond products are sold on—"The user must be satisfied or he returns unused portion in original package for 'Money Back'."

METAL BOND MANUFACTURING CO.
3201 Kossuth Avenue — St. Louis 7, Missouri

HOBART *Arc Welding School*

trains quickly, thoroughly

Classes for MEN *and* WOMEN

Hobart's school is not a war-time offspring. Established long before the war to give experienced operators to the fast growing business of arc welding. ***Instructors Are Expert Welders...*** and they are expert teachers, too. They've all had years of experience showing others the correct procedures of every type of welding.

"Send Your Men to Hobart"
Many plants send men and women to increase their welding operations.

Write Today FOR LITERATURE

HOBART TRADE SCHOOL
Box U-151, Troy, Ohio

YOU'LL BE WISE

To Remember and Investigate Independent Acetylene and Oxygen Cylinders, as to quality and price—available on suitable priorities—let us know your requirements and rating and we will be glad to obtain best possible schedule for you.

INDEPENDENT Engineering Co.
DEPT. 74 — O'FALLON, ILLINOIS

HELP SAVE STEEL
BY APPLYING WIESE UNITS TO AGRICULTURAL TOOLS
Prepare your shop for this type of work

U. S. Patents 2,013,818, 2,051,234 and 2,226,884.

ELECTRIC WELDED
Write for new catalog now
WIESE PLOW WELDING COMPANY, PERRY, IOWA
Originally New Process Plow Welding Co.

Fluxes cost SO LITTLE yet are SO IMPORTANT

Use only those GOOD Guaranteed

"ANTI-BORAX"
FLUXES

No. 1 Cast Iron Welding Flux.
No. 2 Brazing Flux for Brass, Bronze, etc.
No. 4 "Braz-Cast" Flux for Bronze Welding Cast Iron.
No. 5 Aluminum Flux for Cast Aluminum.
No. 8 Aluminum Flux for Sheet Aluminum.
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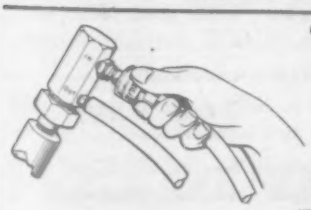
No. 14 Silver Solder Paste Flux.

MANUFACTURED ONLY BY
ANTI-BORAX COMPOUND CO., Fort Wayne, Ind.



SHUT OFF COUPLER

"ELECTROLOY" for RESISTANCE WELDING

Butt
Flash
Spot
Seam
Projection

ELECTROLOY

Catalog and Prices on Request

THE ELECTROLOY CO. INC. 1600 SEAVIEW AVE. BRIDGEPORT, CONN.

FLASH WELDER WITH INSERT

Almarc Electrodes produce neat, sound aluminum arc welds of great tensile strength with high welding speed and little or no distortion of the parts to be assembled.

When properly used the resultant weld is free from porosity and may be polished off to a finished surface.

Alflux No. 1 is a general purpose flux, especially recommended for heavy work such as castings, repairs, etc.

Alflux No. 2 is unrivalled for wrought and cast aluminum, aluminum alloys and magnesium. Especially adapted to aircraft, architectural and light sheet metal work.

Wooldridge Aluminum Welding Products — Glastonbury, Conn.

Here's eye and face protection from front and sides for men and women. The Willson Protecto-Shield with its resilient plastic visor withstands extra impact. Tough brow guard protects the forehead.

Lighter weight and smart appearance of the Protecto-Shield makes it popular to wear. Quickly adjustable head band gives a perfect fit over a hair-do or a man's head.

Comfort begins with the swing up feature. Light weight and comfortable fit permit the Willson Protecto-Shield to be worn for a full shift.

Ask your Willson Safety Equipment Distributor for further information on the Protecto-Shield for light grinding, woodworking and spot welding. Or write for descriptive bulletin.

GOGGLES • RESPIRATORS • GAS MASKS • HELMETS

DOUBLE WILLSON

PRODUCTS INCORPORATED

READING, PA., U. S. A. Established 1870

Whipple Jacobs, president of the Belden Mfg. Co., Chicago, recently celebrated his thirtieth anniversary with that organization. He joined the Belden company as a cost clerk in 1914, shortly after his graduation from high school, and rose rapidly through the ranks. He succeeded Joseph C. Belden, founder of the company, to the presidency in 1939.

» «

Sergeant Anthony J. Zulli, who was an electric weldor in the Todd Shipyard, Brooklyn, before he entered the Army in March, 1941, is now serving as a supply sergeant for a headquarters group of Y-Force in Southwestern China. He is stationed in a huge Y-Force compound in an ancient Chinese city surrounded by a 20 ft medieval stone wall. Zulli is the son of Mr. and Mrs. Frank Zulli of 37 Lake St., Brooklyn.

» «

George Krieger, who has been in charge of the farm machinery division of the War Production Board and more recently special assistant to Donald M. Nelson, has resigned his Government connections to return to the Ethyl Corp., Detroit.

» «

Arnold Peterson, for the past several years with the Navy Department as a radio inspector, has joined the United Electronics Co., Newark, as application engineer. He will assist and advise end users, such as war contractors and distributors, in the proper adaptation of United's products.

» «

E. N. Searles, formerly superintendent of results and industrial relations, has been appointed general installation engineer of the Western Electric Co. He succeeds **F. M. Williams,** who retired after 35 years of service.

» «

Norman G. Brooks, who has been associated with the United States Steel Supply Co. for the past three years, succeeds **William E. Fry** as manager of the Kansas City sales office.

» «

A. J. Schmitz, formerly manager of the Allis-Chalmers Seattle office, has been appointed Pacific regional manager.

Died . . .

S. R. Bergman, who invented the standard d-c generator for arc welding, died Nov. 25 at the age of 67. He had been associated with the General Electric Company since 1902 and was a consulting engineer in the Thomson laboratory of the company's Lynn (Mass.) River Works at the time of his death. Mr. Bergman held 53 patents covering motors and generators. The d-c generator that he developed for arc welding is still a standard in the industry. Among his other inventions were the single-phase capacitor motor and the squirrel-cage repulsion motor.

"GENERAL" WELDING FUME EXHAUSTERS

For effective elimination of the *Noxious Fumes* from

Arc Welding

Galvanized Iron Soldering

Spray Painting, Etc.

TWO TO TEN INLETS—

For multiple hose connections in shop and field operations.

SINGLE INLET UNITS—

For exhaust from booth collector ducts; and in the smaller units.

High Velocity Exhaustion by High Speed Centrifugal Fans for Small, Easily Handled Hoses

SEMI-PORTABLES—

Movable by crane hook or carrying bar; or for fixed (duct) service. ¾ to 15 motor horsepower.

PORTABLE "JUNIORS"—

40 to 100 pounds in weight; one or two inlet nozzles.

Self-closing caps on all nozzles.
Rugged, all-steel construction.
Motored for continuous service.
Controls protected within base.

Bulletin CB-103 gives specifications and dimensions for the 88 types and sizes comprising the "General" line.

GENERAL BLOWER CO.

403 N. Peoria St., CANal 6340

New York CHICAGO 22, ILL. Detroit
Pittsburgh Philadelphia Cleveland

FROM THE PATENT OFFICE

Spot-Welding Apparatus

2,363,753. **Clyde E. Smith,** Port Homer, and **Melvin M. Seeloff,** Warren, O., assigned to **The Taylor-Winfield Corp.,** Warren. Filed April 10, 1943. Issued Nov. 28, 1944.

This patent covers the combination of means to move one spot-welding electrode towards another, a welding pressure-controlling device, a pair of bellows with outer end walls carried by a member connected to the electrode-moving means, and a means of maintaining fluid under pressure in the bellows. The interconnected inner end walls of the bellows are connected to the movable electrode.

» «

Carbon-Electrode Processing

2,364,536. **Henry A. Kent,** Elmhurst, Ill., assigned to **General Electric X-Ray Corp.,** Chicago. Filed Aug. 13, 1943. Issued Dec. 5, 1944.

The method of processing a carbon electrode by immersing the electrode in a liquid gas until boiling ceases and then allowing it to return to room temperature in a dry atmosphere.

Larkin SG Arc Welders

HAVE A STARTING CURRENT OF 5 AMPERES

150 SG (5-150 amperes)

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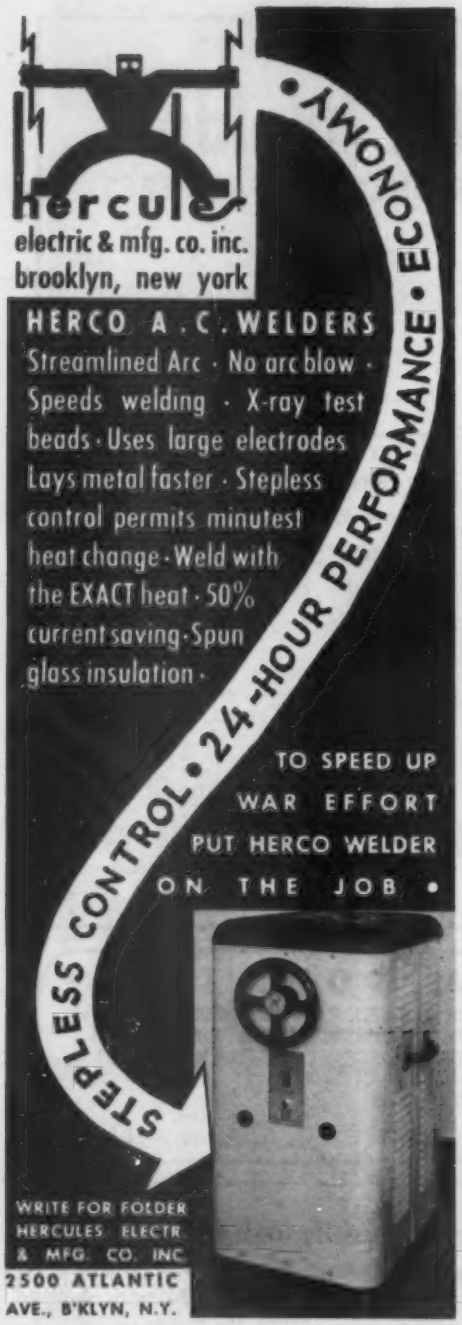
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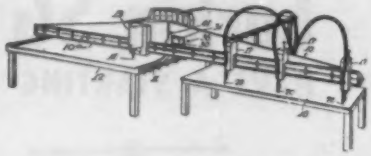
Flame-Cutting Machine

2,364,644. **Chester Mott,** Evanston, and **Alfred F. Chouinard,** Chicago, as-



signed to **National Cylinder Gas Co.,** Chicago. Filed April 4, 1941. Issued Dec. 12, 1944.

A flame-cutting machine with a synchronous motor for driving a movable torch at proper cutting speed over the plate to be cut. Motor is controlled by an electronic device which includes: a means for generating current pulsations of different frequencies, a movable control member having a plurality of rows of conformations controlling the frequency, means for selecting any one of these rows to obtain current of the corresponding frequency for operation, means for amplifying the current pulsations to a value necessary to operate the motor, and means for delivering the amplified current to the motor to operate it at the desired speed.

» «

Flame-Cutting Control

2,364,645. **Chester Mott,** Evanston, and **Alfred F. Chouinard** and **Robert L. Harding,** Chicago, assigned to **National Cylinder Gas Co.,** Chicago. Filed March 31, 1942. Issued Dec. 12, 1944.

This apparatus for controlling the operation of a flame-cutting machine includes a pair of circuits and a pair of electronic tubes. The tubes are of the type which becomes non-conductive when the controlling voltages impressed upon them exceed a predetermined negative value and conductive when the impressed controlling voltages drop below the predetermined negative value. The torch tip is connected in circuit with the metal workpiece so that the flame between the tip and workpiece forms part of the conducting path. Thus the voltages impressed on the tubes will depend on the conductivity of the flame.

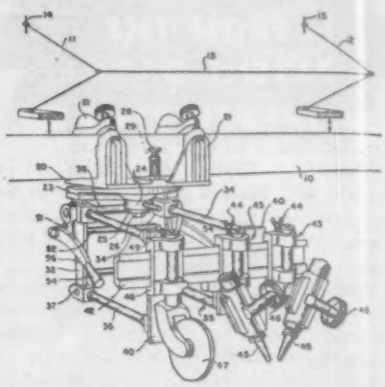
A part of the device is automatically operated according to the conductive or non-conductive condition of the electronic tubes.

» «

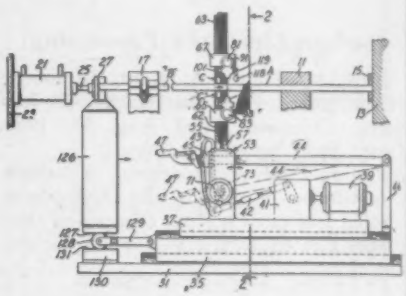
Torch Support

2,363,036. **James L. Anderson,** Closter, N. J., assigned to **Air Reduction Co. Inc.,** New York City. Filed Oct. 28, 1941. Issued Nov. 21, 1944.

A floating support for one or more cutting torches. The folding parallelogram frame is disposed with the axes of its joints substantially horizontal. A bracket connects one end of the frame with a cutting machine, while a hand-operated lever is angularly movable about an axis parallel to the joints of the frame. A cam is connected to the lever, and the cam follower (a crank) is rigidly connected with a link of the folding parallelogram. Cam and cam follower coöperate upon angular movement of



the lever to move the frame and shift the torches toward or from the work. When the torch approaches a raised position, the cam and cam follower move beyond dead center in order to hold the torch in raised position.

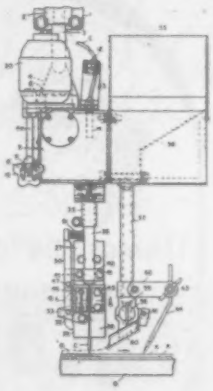


Pressure-Welding Process

2,363,089. **Egon B. Scherl,** Niagara Falls, N. Y., assigned to **The Linde Air Products Co.** Filed Aug. 21, 1942. Issued Nov. 21, 1944.

A butt-welding process in which the members to be welded are placed in abutting relation and forced together under high pressure while the metal adjacent the abutting surfaces is heated to a welding temperature that is not substantially higher than the solidus temperature of the metal. The pressure upsets the heated metal. The major portion of the upset metal is removed by directing at least one jet of a flame upon it.

Submerged-Melt Welder



2,364,826. **Emmett A. Smith,** East Cleveland, assigned to **The Lincoln Electric Co.,** Cleveland. Filed March 16, 1943. Issued Dec. 12, 1944.

In apparatus for automatic metal-arc welding, the combination of a housing, opposed weld-rod feed rolls, means on the housing for guiding the weld-rod to the rolls a tube depending from the housing adapted to receive the weld-rod from the feed rolls and guide it to the work, a flux hopper attached to the housing, a tube extending downwardly from the hopper for discharging flux on the work in advance of the welding operation, means at the lower end of the tube to regulate the rate of discharge of the flux.

In the above device, a support is mounted for traversing movement relative to the work. An arm on the support, adjustable transversely of the direction of such movement, carries the housing. Housing is oscillatorily adjustable about an axis parallel with the direction of movement. A manually operable means is carried by the housing for effecting the oscillatory adjustment. The housing also carries a means to feed the weld-rod downwardly therethrough.

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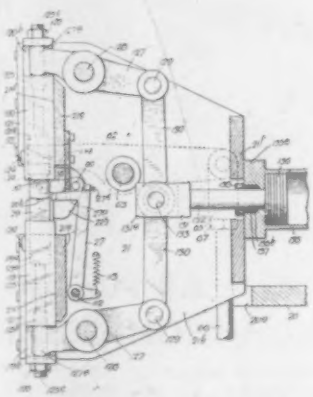


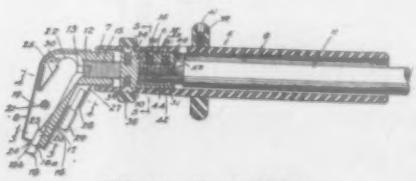
Strip-Welding Method

2,362,388. **Chester M. MacChesney** and **William Schroeder,** Chicago, assigned to **Acme Steel Co.,** Chicago. Filed Sept. 19, 1941. Issued Nov. 7, 1944.

A method of uniting metal strips by seam welding. The oppositely directed ends of the straps are overlapped in substantially parallel planes and heated throughout their width to a forging temperature. A forging pressure is then applied transversely to the overlapped ends.

The equipment for doing the above includes: a means for holding two metal strips with their opposite ends overlapping in parallel planes, means for heating the ends throughout their width, means for applying a forging pressure to them and means for confining the metal of the overlapping ends against transverse flow beyond the initial width of the strips during the application of the pressure.

» «



Electrode Holder

2,364,507. **Arthur A. Bernard,** Chicago. Filed April 3, 1943. Issued Dec. 5, 1944.

An electrode holder having a rigid and a movable jaw. The latter is pivotally connected between its ends to the rigid jaw. The jaws are part of a welding head which has a screw-threaded axial opening in its inner end and also a recess opposite that opening for receiving the inner end of the movable jaw.

» «

Electrode Holder

2,364,508. **Arthur A. Bernard,** Chicago. Filed Dec. 2, 1943. Issued Dec. 5, 1944.

This patent covers the combination in an electrode holder of a body, means for connecting a conductor to it, a head with an inner portion aligned with the body and a first jaw extending at an inclination therefrom, a second jaw pivoting between its ends to the first jaw, a means for rigidly connecting the head to the body and a rigid means engaging the inner end of the second jaw to move the latter about the pivot, thus causing the jaws to grip an electrode.

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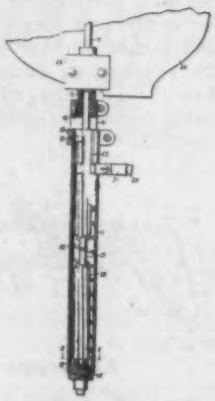
Electrode Holder



2,360,743. **Frank B. Tuttle**, Norristown, Pa., assigned to **General Electric Co.**, Schenectady, N.Y. Filed Sept. 10, 1943. Issued Oct. 17, 1944.

This electrode holder comprises an electrically conductive, resilient rod and a means for twisting and holding it about the longitudinal surface portion of an adjacent welding electrode. There is also a means for connecting the rod to one terminal of a source of welding current.

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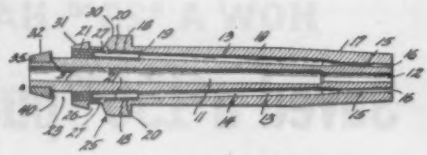

Torch Tip

2,363,250. **Alexander F. Jenkins**, Baltimore. Filed Sept. 25, 1942. Issued Nov. 21, 1944.

A torch tip comprising a body having a passageway extending longitudinally and eccentrically. An annular groove is provided in the outer surface of the tip, adjacent the rear end. The passageway opens through one side wall of the groove, while the opposite side wall is furnished by an annular sleeve fitted upon a rearwardly projecting part of the tip body. The projection is of an external radius less than the radial distance of the passageway from the axis of the tip. The external radius of the sleeve is greater than the radial distance.

» «

Weldor's Helmet

2,362,637. **Warner L. Keehn**, Spokane, Wash. Filed Nov. 19, 1942. Issued Nov. 14, 1944.

In a weldor's helmet, a window projecting forwardly at the front, an inwardly projecting flange having a lip projecting rearwardly into the window, a lens consisting of an upper black glass and a lower transparent glass, a transparent sheet in the window covering and protecting the outer surface of the lens, a retainer frame in the window engaging marginal portions of the upper and lower glasses and holding the glasses and the protecting sheet firmly against the lip of the flange. An open frame of resilient material is fitted into the window against the outer surface of the upper glass, and its upper portion is engaged by the flange and its lip to hold the frame in place. A visor is formed integral with the frame and projects forwardly from the lower edge at a downward angle.

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